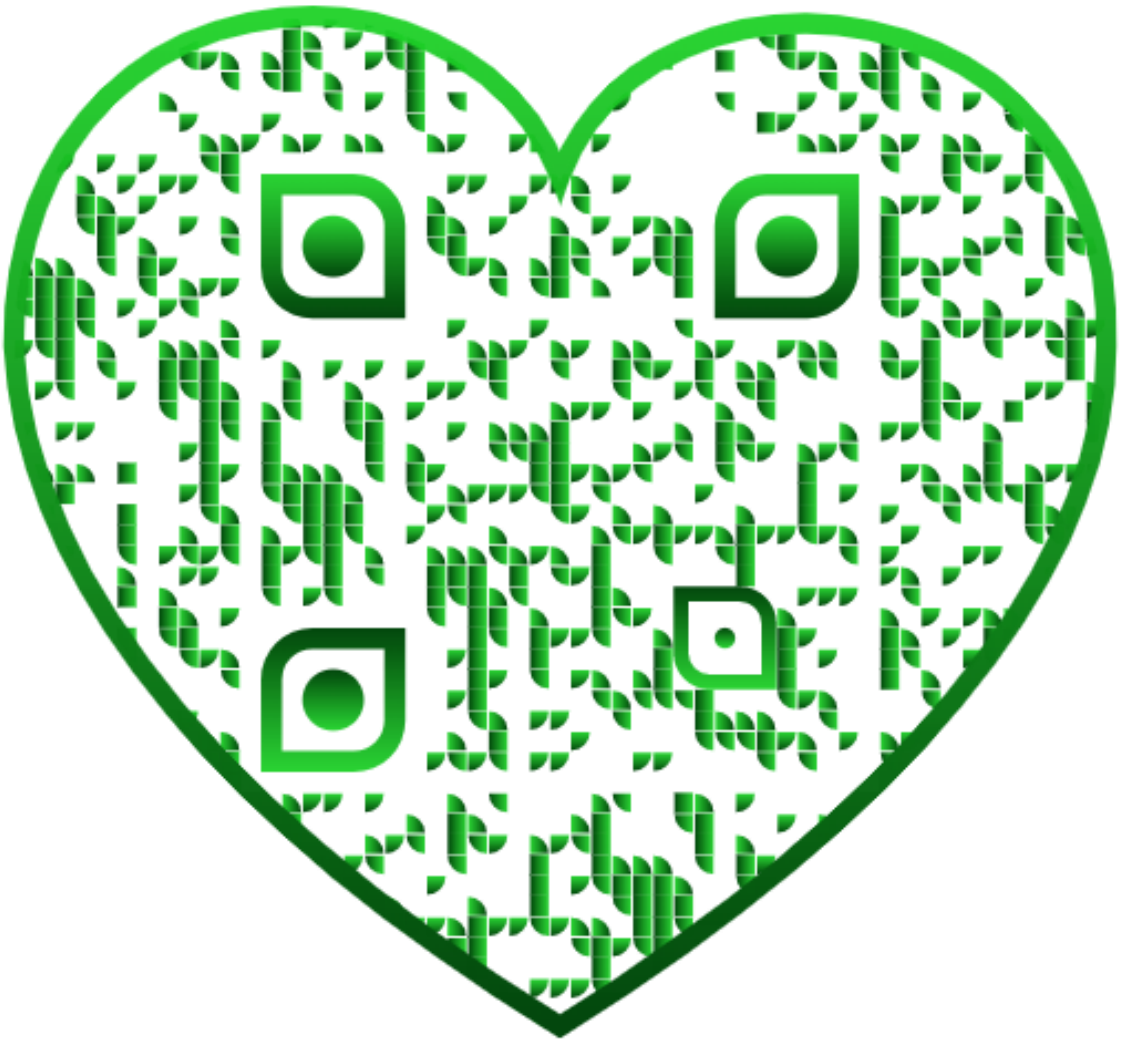
Todd
Murphy

The God Helmet Experiments

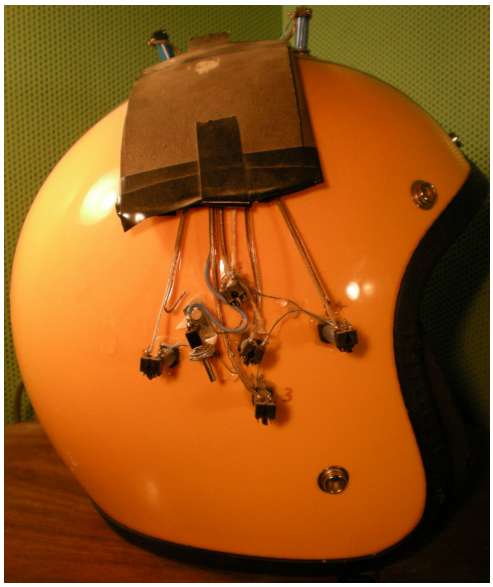
The Science That Found God In the Human Brain.

**Simplified versions of the God Helmet papers,
Originally written by Dr. Michael Persinger
and his many colleagues.
Edited into easier reading by Todd Murphy**



THE GOD HELMET EXPERIMENTS

The Science that Found God in the Human Brain



Based on Research Papers by Dr. Michael A. Persinger

Edited by Todd Murphy

Copyright, 2019 by Todd R. Murphy. Updated 2024.

All rights reserved. No part of this work may be reproduced in any form or by any electronic or mechanical means, including information storage or retrieval systems, without permission from the author, except by a reviewer who may quote brief passages in a review.

First CreateSpace Edition, revised and corrected 2024

Murphy, Todd Raymond

"The God Helmet Experiments" / Todd R. Murphy

1st Edition (Revised)

1) Neuroscience 2) Religion 3) Brain
Printed in the United States of America
23rd of August, 2024 (Rev.2, 00.00.2024)
ISBN: 9781702117517

DEDICATION

This book is dedicated to the memory of Dr. Michael A. Persinger.

Table of Contents

ACKNOWLEDGMENTS

1] INTRODUCTION

2] Simulating the God Experience

3] Paranormal Experiences & The Brain

4] Lab Induced Mystical and Altered states

5] Religious & Mystical Experiences & the Temporal Lobes

6] OBEs From The God Helmet

7] The Sensed Presence: When left/right Communication is disrupted.

8] The "Sensed Presence" in Normal Subjects & in a "Medical Intuitive".

9] Inducing a Laboratory Ghost. A Case \History

10] God Helmet Sessions are VERY Pleasant

11] “Feeling” the words around us without even hearing them

12] Enhancing Hypnosis.

13] Perceiving Magnetic Fields After Taking LSD.

14] Stimulating the Right Side - More Pleasant using a 'memory signal'

15] The God Helmet Reduced Depression (From Traumatic Brain Injury)

16] Reducing Depression in Patients with Brain Injuries (EEG Validation).

17] Decreasing Depression in Normal Subjects.

18] Different Magnetic Signals have Different effects (Depression, etc) .

19] Weekly God Helmet Sessions are more Effective than Daily sessions.

20] The Sensed Presence Depends on the Specific Signals Used

21] Nine Blogs by Persinger & Murphy responding to critics

ABOUT THE AUTHOR / EDITOR

ACKNOWLEDGMENTS

My thanks to all those who worked on the God Helmet Experiments, including Stan Koren, Dr. Kenneth Saroka, Blake Dotta, Linda St-Pierre, Eric Tsang, Gyslaine Lafrenière, and a host of graduate students.

CHAPTER ONE

INTRODUCTION

The God Helmet experiments are best known for the fact that they were able to elicit visions of God for a small percent of the subjects who participated. It stimulates the brain's temporal lobes with low intensity magnetic signals to create altered states of consciousness and religious and mystic experiences. Although this book has a review article summarizing the research on creating visions of God in the laboratory, the experiments that led to this striking result were dedicated to researching another phenomenon: "the sensed presence." It refers to the strange feeling that someone or something alive is in the room with you, but when you turn to look, you find no one is there. Fully exploring this simple illusion, Dr. Michael Persinger arrived at an understanding of what happens in human brain when a person has a "God experience". The sensed presence is often a subtle feeling, but when it's amplified into something more powerful, it manifests as a

nonphysical being, like a ghost, an Angel, a spirit, a deity, or even God.

There were no specific experiments designed only to produce the experience of God. Instead, Persinger's evidence for understanding the nature of God appeared in the most extreme responses to his procedure for inducing the sense presence. God, as he appears to the few people who meet him face-to-face while they are still alive, is an extreme example of the same phenomenon that appears as the sense of a presence. By the time he reached the point where he'd used his procedures for inducing the sense of a presence with approximately 2000 subjects, he had found that about 20 of them had reported that they had seen, felt, or even spoken with God directly. He also told the editor of this book that he suspected that many more of his subjects had the experience, but were hesitant to report it to the laboratory staff. It's easy to understand. Reporting an experience like that can earn ridicule from some people, and the first-hand experience of God can be extremely intimate, so many would prefer not to talk about it.

Dr. Persinger was always very concerned with complete accuracy in his published papers; so much so that many of them are extremely difficult to read for laypeople, even those with some background in science. For example, here is one quotation about *temporal lobe signs*, which are subtle and usually spontaneous altered state experiences, like déjà vu, sensing a presence, nighttime creative bursts, hearing inner voices, etc.

> "This index of phenomenology that is similar qualitatively to the experiences reported by individuals with verified electrical foci within the temporal lobes is suspected to be a fundamental neural process by which the effects of ambient geomagnetic suppressed melatonin-related mechanisms can lower the threshold (increase the probability) for electrical seizures within the amygdala and the hippocampus."

In simpler language, the same sentence comes out like this:

> "These phenomena are similar to the experiences reported by people with temporal lobe epilepsy, and may be a basic brain process that allows geomagnetic activity to reduce melatonin levels, making seizures that begin in two very sensitive brain

parts, (the amygdala and the hippocampus) more likely."

It's easy to see how rewritten versions of Dr. Persinger's papers will make his work more accessible to the public as well as to the scientific community, especially for scientists who are interested in the meeting of science and religion, but who aren't neuroscientists. Dr. Persinger's work has received a huge amount of attention from people who are interested in exploring consciousness, and are fascinated with new kinds of science. This book will also help them to understand what Dr. Persinger was actually saying, without having to gather information from media sources. The news media was fascinated with Dr. Persinger's work, but very few journalists have the training in neuroscience to read his published papers. The editor of this book hopes that it will fill this gap, and make it possible to understand how the brain is involved with mysticism, religious faith, and prayer. The re-writes have been done on a sentence-by-sentence basis, both to prevent any copyright issues, and to ensure that as much of the original meaning is preserved as possible. However, in some cases, sentences have been rearranged and occasionally, cut out when it was unavoidable. Being faithful to the original papers has meant that a number of phrases are repeated more often than a good literary style would usually invite.

Dr. Persinger's papers on the God helmet examine its design on a more or less point-by-point basis. The most effective stimulation procedure consisted of applying one signal over the right side of the brain, followed by another signal, over both sides. So, for example, there are several research studies involving stimulation of only one side, and several more examining stimulation of both sides. These are often explored separately.

To accomplish its effects, the God helmet relies on stimulation of both sides of the brain as part of its most successful procedure. There are several studies that report the effects of stimulation of both temporal lobes at once; including one that records the "pleasantness" of stimulation using this signal that was applied to both sides simultaneously.

The most successful God helmet session design also included stimulation of only the right side. It was partly discovered following several studies that stimulated only the temporal lobes on the right side of the brain, with several

effects including the sense of a presence, and even hypnotizability. These studies may look like they have little bearing on the development of the God helmet, but if these studies hadn't been carried out; the God helmet probably wouldn't exist today.

We can't understand the God Helmet without understanding something about the brain, so one paper isn't about the technology at all. It's about the parts of the brain it stimulates: the temporal lobes, especially a couple of its deeper parts, the amygdala and the hippocampus. Understanding what they do, especially their role in maintaining the "sense of self", will help us understand how the God helmet can evoke religious and mystic experiences. The effects of the God helmet are similar to the effects of an increase in temporal lobe sensitivity. One of these, as seen in temporal lobe epileptics, is more frequent *temporal lobe signs* (such as déjà vu, sensing a presence, illusions of movement, tingly sensations, the sense that everything is unreal, etc.). Because of this, several papers correlate temporal lobe signs with several other phenomena. They may not help every reader to understand the God helmet more deeply, but they were an important part of the research that led up to its development.

In 2004, a researcher who tried to do a replication of Dr. Persinger's sensed presence experiments (but who distorted the signals, and failed to apply them long enough), alleged that Dr. Persinger failed to use placebo controls or double-blind conditions. This is simply not true, as you'll find in this book. One of the reasons this could have happened is that Dr. Persinger referred to his placebo as a "sham field". The researcher who didn't want to take time to review Dr. Persinger's published papers might have simply searched for the word "placebo" and Persinger's name in a medical database, such as pubmed.com. As it happens, Dr. Persinger used the word *sham* far more often than *placebo* (such as, for example, "sham" stimulation, instead of "placebo" stimulation). This could lead them to conclude that Dr. Persinger did not use placebo controls. To avoid this confusion in vocabulary, the word *sham* has been replaced by the word *placebo* in most cases.

A great deal of math has been left out of the material in this book (sometimes including some of the actual measures of an experiment). Persinger was a first-rate mathematician, and his statistical analyses are often

so detailed, and his reporting of them so complete, that most readers simply won't be able to follow them. Even the editor for this volume had a little trouble keeping up with them. Besides, the point of this book is to make Persinger's discoveries available to the public, and that means leaving out some of the math, which so few people would be able to understand.

In many cases, the phrase "temporoparietal area" has been replaced with "temporal lobes," as Persinger often used the phrases interchangeably. Temporoparietal refers to the temporal lobes, including some of the parietal lobes, immediately above it.

There's more repetition here than you'll likely see in other scientific books. That's because Persinger repeated a lot across his papers. In a few cases, (like the description of how the signals are produced), some redundant material has been removed from all but one of them, because the discussions are almost identical. The original research papers often repeat certain phrases, and some of this has been preserved in these simplified versions for the sake of faithfulness to Persinger's actual writings. Even though this book is designed for easier reading, clarity and continuity are also high priorities. Further, some points of God helmet experiments are repeated enough to help the reader learn them. Repetition is boring, but it's also "the first law of learning".

Words in square brackets [like this] are notes from the editor, who has been a member of Persinger's group since 1998. These notes may be the editor's own comments, opinions, or be added to clarify the text of the paper. In some cases, there may be differences between my rendering and the original paper. Usually, these reflect differences in language, like using the word *spiritual* instead of *religious*. Sometimes, one paragraph in the original paper might be broken into two in my re-write. There are also a few comments that put Persinger's research results in context, comparing results from one experiment to the results of previous ones on the same or similar subjects.

There are few references or footnotes. This means that scholars following up on the papers presented here will need to rely on the original scientific papers, not the simplified versions in this book. That's how it should be. If

you want to see the source for something, the best thing to do is look it up in the original paper. The reference for each paper is at the top of the first page for that chapter. The papers are all online, and they're easy to look up. At this time of writing, most of them could be found at http://neurosciarchive.byethost12.com/

This is an experimental book. So far, no scientist's published papers have ever been re-written to make then easy to read, but regrettably Dr. Persinger never published a book summarizing his own work. He published over 500 papers, most of them in peer-reviewed journals, and even a partial summary would have needed a scholarly Hercules.

Persinger covered many themes in his work, including spirituality, neuro-physics, consciousness, his famous God Helmet, psychic skills and perception, the effects of different states for the earth's magnetic field, and many others. Each person looking at the whole of his work will see it differently. Some would emphasize the paranormal themes. Others would put his clinical work first. Many readers might think it strange that anything besides laboratory induced mystic experiences should appear in this volume at all. I've tried to include several of these themes and subjects, including some of Persinger's articles written in reply to his critics. These may be less interesting for some readers, but they're an important part of his work with the God Helmet. Some of his detractors never even mention that Persinger published any replies, so it's important that they be here as well. Some of Dr. Persinger's critics have alleged that his experiments didn't use placebo controls or blind conditions. Reading the actual research publications, or their simplified versions in this book, you'll find that this simply isn't true. About 20% of this book is dedicated to these debates.

Much of Persinger's work involved stimulation with *complex magnetic fields*, basis for the God Helmet's technology. These are fields that fluctuate, getting weaker and stronger every few milliseconds, to form specific signals. In many cases, your humble editor has changed the name for them to 'magnetic signals,' 'signals embedded in magnetic fields' or 'signals applied using magnetic fields'. All of these are correct, and I've changed the name to keep the nature of the stimulation clear. The word *complex* isn't clear for many readers. In fact, it refers to signals that can't be described by their

frequencies, like a signal that matches the shape of a city skyline.

I have to say that I, your editor for this volume, am responsible for any errors. If you spot any, please let me know, and I will make every effort to correct them in future editions of this book. Today, online publication makes it easy to replace one edition of a book with another, so errors are easy to fix.

Finally, let me say that I hope you like this book, and find it a fascinating addition to your understanding of human consciousness and our species' search for meaning and spiritual understanding. Dr. Michael Persinger's work is a treasure trove of insight and wisdom about human experience, locked in a chest made of the formal academic language that gets work published in scientific journals. I earnestly hope this book provides a key.

CHAPTER TWO

Experimental simulation of the God Experience: Implications for religious beliefs and the future of the human Species.

"Experimental simulation of the God Experience: Implications for religious beliefs and the future of the human Species." Appeared in: *NeuroTheology: Brain, Science, Spirituality, Religious Experience, California University Press,* 2002, Rhawn Joseph, editor.

Summary - We've been able to elicit the experience of a "sensed presence" or a "sentient being" in normal people by applying low intensity magnetic fields with embedded complex signals. Our hypothesis to explain these episodes [whether occurring naturally or induced in our laboratory] is that they're the experience of the part of the human sense of self maintained in left side, perceiving the one in the right side of the brain. They are the mildest example of a "visitor experience" (the perception of a nonphysical being). The experience of God is an extreme example of the same phenomenon [without regard to whether or not it occurs by the will of a supreme being]. Our experimental results and clinical measures support this conclusion. We humans have natural brain functions that allow us to avoid challenges to religious beliefs, which have a lot in common with delusions. Some of the brain activity involved in the God experience [which includes beliefs, adherence to scriptures, as well as the first-hand experience of God's presence], is also involved with aggression. About 50% of males who had religious experiences, go to church regularly, and are found to have more frequent temporal lobe signs say they would be willing to kill in God's name, and this could have a strong impact on humanity's future.

Introduction

One of the fundamental principles in behavioral neuroscience is that all of our experiences are created by, or correlate with, specific kinds of brain activity. [*Mental forms follow neural functions*.] This activity is controlled by

electrical and chemical activities in and between small brain structures. Just as structure determines function, small-scale structures determine small-scale functions.

This principle operates in several ways. The first is that all but a few kinds of experiences or perceptions are responses to objective events and stimuli.

The idea that mental forms follow neural functions forces us to see that all religious experiences and states of consciousness, from heightened awareness of the self, to feelings of love and devotion, and the direct perception (or vague sense) of God's presence, are reflected in [or reflect] the brain's activity. If science can isolate the stimuli that elicits an experience, then it should be possible for any experience, including seeing God (or feeling his presence) to eventually be investigated, verified and reproduced in the laboratory, by applying that same stimuli.

In one of our case histories, in 1983, we did a routine EEG study to examine the effects of transcendental meditation™. During this study, an experienced TM instructor showed an electrical anomaly over her right temporal lobe. Simultaneously, during this "electrical seizure," she said she was "filled with the spirit" and that she felt the presence of God with her. This happened in a laboratory, not a church or temple. The electrical event we saw on her EEG, which lasted about 20 seconds, happened at the same time as her religious epiphany.

An obvious question appeared. If we found the essential electrical process in the brain that correlates with the experience of God, and then elicit the same process or electrical activity in people without them knowing what the stimulation was for, would some of them experience God? There are many clinical records of patients with complex partial ("temporal lobe") epilepsy, focused in the limbic system or the temporal lobe on the right side, who also had mystic experiences and contact with God. Of course, many of these patients were reported in the medical literature before the technology to design the experiment existed.

The search for the self leads to the sensed presence [& vice-versa].

One of the last remaining challenges in neuroscience is to understand the brain's foundations for the sense of self. Some of its basis seems to be in verbal processes, supported by language centers on the surface of the left side of the brain. The human sense of self is, in part, based on language. People often show themselves willing to fight and die to preserve their culture and their language, especially the specialized vocabulary of their religion [including words like "salvation, "defilement", "Prophet", or "God", without which it's impossible to express religious beliefs]. Their importance looks like a simple extension of the way people identify with the words they use. Challenging their meaning is taken as an assault on the person, especially if the words are part of the foundation of their religious beliefs. Without language, the sense of self, as we humans know it, would not exist.

In the late 1980s, our research group was investigating the brain's role in creativity and insight. Many of the great minds in human history, including scientists and people who founded religious and spiritual traditions, have said that their insights happened along with a feeling of communion with something greater than themselves. The knowledge, information, and insights appearing in these moments often went beyond anything that they'd learned or encountered during their lives.

To study this phenomenon, we developed a computer-based technology to apply complex (irregular) signals, carried by weak magnetic fields, through the brain. The basic procedure involves seating the blindfolded subjects in a completely silent [and vibration-proof] darkened chamber (which is also a Faraday cage, which admits no wireless signals). The idea was to imitate the cave-like conditions in which so many "inspirational insights" had appeared to people throughout history. Blocking out vision and hearing from their minds would allow many pathways to respond to the experimental magnetic signals that would usually be busy, monitoring the environment.

Most of our subjects [80%] reported that they sensed a presence, sentient being or "entity" in the chamber with them. The subjects were more likely to report the sensation, and interpret it as a "being" according to three factors. 1) Their temporal lobe sensitivity, as measured using EEG and their answers to a questionnaire. 2) Their beliefs about nonphysical living things. 3) The

shape or pattern of the signal embedded in the magnetic fields. The subjects had strong emotional responses to the sensed presence, and they also found the presence to be personally significant, [as though the being they experienced in the laboratory was speaking to them personally, or concerned with their welfare]. The way the subjects remembered these experiences was strongly influenced by the way they explained it within a few seconds of the event.

We work with the hypothesis that the sense of a presence is a “prototype” [or intimation] of the God experience, and that it’s actually a brief moment when the “self” on the left side of the brain is aware of its counterpart operating out of the right hemisphere. The electrical activity in the left hemisphere of the brain that generates the sense of self experiences the person’s right hemispheric “self” as another being when it intrudes into its awareness.

The “self” on the left side of the brain is the “default” sense of self, which operates in our normal states of consciousness. We identify it as “me” or “myself.” The activity supporting the two selves is normally kept separate, each mostly staying on its own side, and we sense a presence when they intrude on one another. It usually doesn’t happen very often for most of us, except perhaps when we’re dreaming, but many people should expect them from time to time, given the fact that the hemispheres are “empowered” to inhibit one other. These “intrusions” become more likely during times of personal crises, depression, during meditation, or under the influence of certain drugs.

> *The Sensed Presence happens when the 'self' managed by the left side of the the brain becomes aware of the 'self' that's managed on the right side. Neither of them are completely independent. They each receive contributions from the other, and there are always pathways connecting them. When these pathways don't have their usual controls in place, a person can be aware of their two 'selves' at the same time, and the 'right-sided self' is projected into the space around them, where it's perceived as a being outside themselves - Editor*

Because these episodes involve a disproportionate contribution from the right side of the brain, the features, phenomena, and "properties" of the right hemisphere figure prominently in their details. Thus, they can be profoundly emotional, and feel larger-than-life (for instance, seeming to happen on a cosmic scale). In the same way, they can be fraught with profound meaning, and exceed the "boundaries of the self," and go "beyond words." Our EEG measures, together with the themes of the experiences, show that they involve the area where the temporal and parietal lobes meet, as well as the amygdala (associated with emotion and cosmic meaning) and the hippocampus, the gateway to memories and inner images. The most common themes and sensations that happen along with the sensed presence sensation include vibrations in the body, dreamlike states, out-of-body experiences, feeling like one is spinning, as well as fear, anger, or sexual arousal.

In one example, a 21-year-old diabetic woman was given a burst firing signal (from the amygdala), said "I felt a presence behind me and then along the left side. When I tried to focus on its position, the presence moved; every time I tried to sense where it was, it would move around. When it moved to the right side, I experienced a deep sense of security like I have not experienced before. I started to cry when I felt it slowly fading away (we had changed the signal). The task of focusing on the "being's" position would have changed the electrical activity in her brain. The magnetic signals would have integrated with the (mildly different) brain activity from that task, and the experiences, as well as the way she interpreted them, also changed.

[Persinger refers to this case history several times in his papers.]

Different magnetic signals have produced different sensations [and they aren't all equally as effective in producing the sensed presence]. For example, a woman who received a different (frequency-modulated) field over the right side where the temporal and parietal lobes meet said that she felt "detached from my body … I am floating up… There is a kind of vibration moving through my sternum… There are lights or faces along the left side. My body is becoming very hot… Tingling sensations in my chest and stomach… Now both arms. There's something feeling my ovaries. I can feel my left foot jerk. There is someone in the room behind me. The vibrations are very strong now. I can look down and see myself." [She had an out-of-body experience, but not a sensed presence.]

We've been impressed by the common themes of these experiences, as well as their extensive overlap with the phenomena of specific neurological functions. They've been reported by hundreds of university students and other groups (including visiting journalists) during last 15 years. [This article was published in 2002.] Although older people, artists, musicians, writers, and women in general are more introspective, the themes and phenomena of their reports from specific magnetic signals have been consistent. Nevertheless, each person's experience is unique, and tends to reflect their beliefs, as well as the names they've learned for them. [One person might experience Christ, while another might feel they were in Allah's presence. Both would feel they were in the presence of a deity. Another might feel that the spirit of a deceased relative was with them, while someone else might feel that there was a nature spirit nearby. Both would feel a spiritual presence. We could say that the form comes from the stimulation, while the content reflects the person's belief, life experience and private symbolism.]

In another example, a 25-year-old man who received the (frequency-modulated) signal over both sides of his head said: "I felt as if there were a bright white light in front of me. I saw a black spot that became a kind of funnel… No, tunnel; that I felt drawn into… I felt (I was) moving, like spinning forward through it. I began to feel the presence of people, but I couldn't see them; they were along my sides. They were colorless and grey-looking people I know I was in the chamber, but it was very real. I suddenly

felt intense fear and felt ice cold."

Applying these magnetic signals over the right hemisphere in our lab experiments has regularly generated experiences of God or other religious beings, especially in people who believe in them. For example, a 50-year-old man, who said he felt the presence of the Virgin Mary or Christ often in his daily life, volunteered for one of our experiments. Without him knowing how long each signal would be applied, he let us know (by pressing a button) when he had the sudden "feeling" or the actual "visual presence" of Christ on his left side. These happened when a specific signal was applied over the right temporal lobe. It imitated a pulse sequence associated with memory creation (long-term potentiation in hippocampal tissue). Presenting this signal repeatedly produced and obvious (but reversible) normal response. It reduced the amount of alpha EEG activity measured over both occipital lobes and the right parietal area.

Over the years, many people have asked us what atheists experience from the same stimulation. [As of 2002,] We've worked with about 20 people who identified themselves as atheists[1], primarily experts in various sciences who visited our laboratory. They also reported the sensed presence and out-of-body experiences, but explained them as coming from their own minds, instead of a sacred source separate from themselves. They often compared the experiences to the states of consciousness created by hallucinogenic compounds. These results strongly support the idea that the feeling of a "sentient presence" is within the normal repertoire of experiences generated by the brain, and reflect its architecture and functions, which contribute to our survival. [The emotional and mental effects of sensing the presence of a nonphysical being, real or illusory, are part of the human survival strategy, even though not everyone is equally prone to these episodes. In fact, they may provide alternate cognitive styles that allow humans to solve problems and take advantage of opportunities.]

The Experimental Procedure and Technology

Many previous studies on the effects of magnetic neural stimulation have used very simple magnetic fields. In contrast, we believed that the complexity

and information content in the magnetic fields was more important than the field strength for our experiments. We could compare it to studying biochemistry using two molecules, like hydrogen and water, (because they're simple and easy to work with), which wouldn't have allowed the special properties of more complex organic chemicals, like nucleic acids or proteins, to be discovered.

We can compare our complicated, irregular low intensity magnetic fields used to influence neurons to the complexity of the spoken word. Suppose you were studying, and a 1000 Hz sine wave was played in the room with you. Most likely, you wouldn't respond unless it was loud enough to be irritating. In contrast, the complex mix of frequencies that produced the sound of someone saying, "God is here" or "help me" would get your attention even if it was very quiet. The difference is that the sound of the spoken words *means* something, while the sine wave doesn't. The information in those words is encoded in asymmetrical complex sound patterns, and the way you heard them, as well as how you explained them, could have a powerful impact on the way you behave, either in that moment, or for the rest of your life.

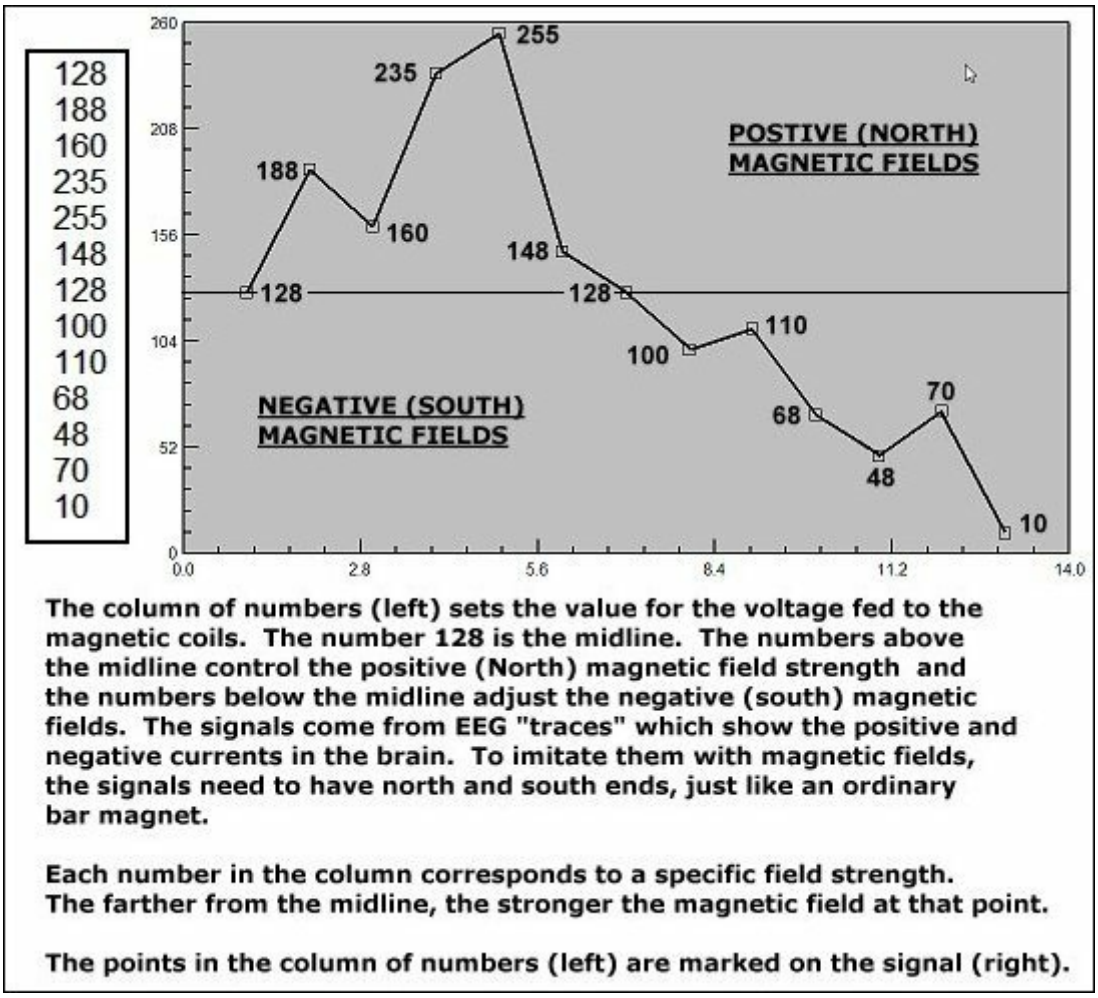
We learned that the signals in our magnetic fields are most effective when they imitate the ones that the brain produces naturally. We derived these signals, magnetic images of the brain's electrical activity, both from the activity of neurons, singly and in groups, from EEG patterns and measurements. We converted them to columns of numbers, and fed them to a *digital to analog converter*, which converted the values for the numbers into electrical current. Each number corresponds to a specific voltage, and the fluctuating electrical current was fed to magnetic coils attached to a person's head, which then produce magnetic fields that also fluctuated in the same pattern.

To avoid any direct current induction from them, and to prevent physical vibrations, the magnetic coils never touch the person's scalp. Instead, the coils were built into a helmet so they were located over the temporal lobes, including the region where the temporal and parietal lobes meet. We also used an alternative hardware arrangement, where the coils were placed in containers that could be located over any part of the brain and held in place with Velcro. The eight coils are placed above the scalp just above the ears,

with four coils on each side of the head. These were designed so that the headsets could produce magnetic fields that ran through the brain from one side to the other, or could be rotated around the head.

There are four major design features in these magnetic signals. 1) The shape of the individual signal. The changing values in a column of numbers (a data file) change the strength of the magnetic field. If the signal is displayed on a graph, the farther a number is from the midline, the stronger the magnetic field strength. 2) The length of time each number in the data file is "played." This sets the length of time each "blip" is produced by each coil. In both humans and rats, the most effective "point duration" is between one and three milliseconds. 3) The length of time between each "run" of a signal. For example, our burst firing signal, designed using an EEG pattern from the amygdala (first seen in epilepsy, and later also found in normal people) seems to have its greatest effects when delivered once every four seconds for about 20 minutes. In rats, it was seen to result in analgesia equivalent to 4 mg per kilo of morphine. Presenting this signal continuously, without the four second gap (a "latency") between each run, didn't have the same effect.

The fourth design feature is how long the stimulation using a single magnetic signal lasts. Most of our experiments have been confined to stimulations lasting between five and forty minutes. This helped us develop further research strategies and to investigate potential clinical applications, [as well as to elicit altered state experiences]. Although repeating the same pattern can elicit simple sensations within about two minutes, presenting a sequence of different signals (for 2 to 5) minutes each appears to be sufficient for their effects to be seen on EEG, and to elicit more complex sensations. [In most "God helmet" stimulation sessions, two signals are used, for not less than 20 minutes each.]



The column of numbers (left) sets the value for the voltage fed to the magnetic coils. The number 128 is the midline. The numbers above the midline control the positive (North) magnetic field strength and the numbers below the midline adjust the negative (south) magnetic fields. The signals come from EEG "traces" which show the positive and negative currents in the brain. To imitate them with magnetic fields, the signals need to have north and south ends, just like an ordinary bar magnet.

Each number in the column corresponds to a specific field strength. The farther from the midline, the stronger the magnetic field at that point.

The points in the column of numbers (left) are marked on the signal (right).

We use three different methods to measure the experiences associated with our magnetic signals. First, we record what the subject says during the stimulation. These reports come immediately, in real-time, and consist of the subjects own words, which we can analyze later on for their emotional meaning. One disadvantage of this method is that talking too much can interfere with the experiences. [Talking excites language centers, located on the left side of the brain, while many experiences rely on predominantly right hemispheric functions. Too much of one can interfere with the other. For example, meditation calls people to turn their attention away from verbal thinking. When people come out of a trance or meditation, they often need a few minutes to collect their thoughts and begin to talk again.]

Our second technique has been to ask the subject’s questions after the stimulation session is over, following a questionnaire. They’re asked to rank how often they felt typical sensations or underwent specific experiences. This

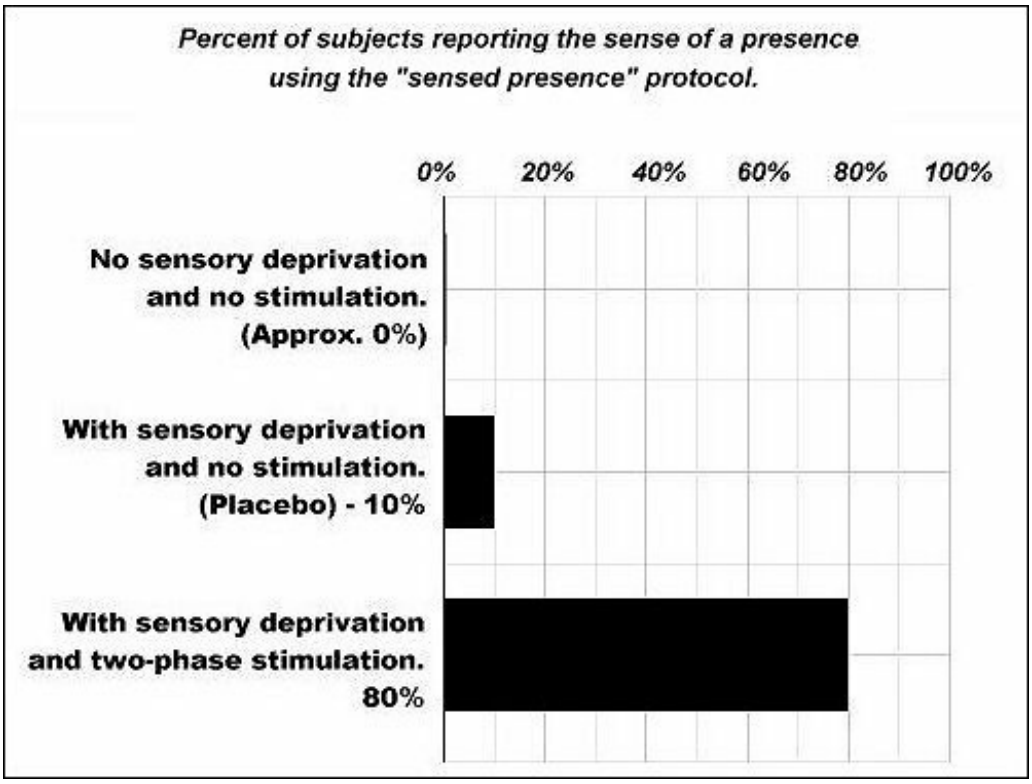
technique doesn’t require the subject to talk during the stimulation, which would compete for their attention while the phenomena are happening in real time. One disadvantage of this technique is that, like dreams, the experiences can be forgotten quickly if they aren’t recalled soon after they occur. Moreover, the content of the questions can influence a person’s memory of the actual experience. [For this reason, the questions are kept as neutral as possible, and a placebo field is used in the experiments.]

Another technique we used to gather the “sensed presence” data in some experiments was to tell the subject to press a button on their left when they feel the presence on their left side, and to press another button on the right when they feel it on their right. In this way, we can record the exact time the sensation occurred, and look at their EEG recording from the same instant. The subject doesn’t have to disrupt the “flow” of their experiences by talking about them. Recording the button presses, and comparing them to EEG, allows us to apply several different signals and see which one was most effective in producing the sensed presence for that individual. One disadvantage of this method is that it leads the subjects to expect the sensed presence, and may make it difficult for them to pay attention to other experiences and sensations. This limitation meant that the button press method could not be used in all of our experiments. [Even though this procedure tends to create expectations, we can still use placebo (“sham field”) controlled conditions, where neither the experimenter nor the subject knows if they were receiving the stimulation or not. Our intake procedure included informing the subjects that they may or may not receive magnetic field stimulation, introducing a tendency for them to be a bit doubtful about whether they’d receive the stimulation or not.]

Neither the subjects nor the laboratory technician (usually a graduate student or senior undergraduate student) applying the stimulation knew the hypothesis for the specific experiment. The subjects were told that it was concerned with relaxation or memory (a “misdirection”).

The location for the coils is another important point in the stimulation’s design. [Placing the coils over the temporal lobes was found to be more effective for producing the sensed presence, stronger apparitions, and even the experience of God, then any other cerebral location.]

Several of our experiments, which involved around 100 subjects, made it clear that the most effective procedure for inducing the sense of a presence is a two-phased stimulation session. The first phase applies a frequency modulated signal, so it “loops” without a break, to only the right temporal lobe for 15 [or 20] minutes. In the second phase, we apply the burst-firing signal[2] to the temporal lobes on both sides (once every three or four seconds) for the same length of time. If the feeling of a presence appears in the first phase, it feels as though it’s on the subject’s left side, and tends to feel more apprehensive or anxious. If it appears in the second phase, the “being” feels like it’s on either the right side (or both sides), and it’s most often pleasant, even spiritually uplifting.


Percent of subjects reporting the sense of a presence using the "sensed presence" protocol.
0%
20%
40%
60%
80%
100%
No sensory deprivation and no stimulation. (Approx. 0%)
With sensory deprivation and no stimulation. (Placebo) - 10%
With sensory deprivation and two-phase stimulation. 80%

About 80% of our subjects who receive this two phased session report that they felt a presence. There were a lot fewer reports of the sensed presence when we applied the same stimulation in the opposite order. In most of our experiments, only about 10% of the people exposed to the placebo condition [applied in complete darkness and absolute silence] felt the sense of a presence. Most of these subjects also had more frequent temporal lobe experiences [such as déjà vu, the sense of a presence, tingling sensations, and

illusory feelings of movement] in their daily lives than normal, (measured with a questionnaire that asked about these “temporal lobe signs”). [We should take note that sensory deprivation provides a context for several types of altered state experiences, making it unlikely that control subjects, receiving placebo (zero strength) magnetic fields in our sensory deprivation chamber would report nothing at all. The critical point is not whether control subjects had anything to report, but rather the difference between subjects and controls.]

The “shape” or “profile” (also called the “pattern”) of the signal appears to be the most important feature for eliciting the sensed presence. [Other signals are more likely to elicit other phenomena, such as the frequency modulated (“chirp”) signal, which has generated many reports of seeing an “infinite space,” and out-of-body experiences, which occur much less often with the burst firing pattern. [Another signal, derived from activity in the hippocampus while memories are being formed, doesn’t produce the sensed presence experience very often, but it does create a strong sense of pleasantness, when it’s applied over the right side. In contrast, the burst firing signal is associated with negative feelings over the right hemisphere and positive feelings over the left.]

Figure 2 (below) shows the results of exposing approximately 100 subjects to a number of different signals, applied at different speeds. The most effective configuration in this group (which doesn’t include the burst firing signal) was the frequency modulated (“chirp”) signal, when it was applied with 3 milliseconds for each voltage value (“pixel”) in its column of numbers. When the signal was “played backwards,” it lost about two thirds of its effectiveness. Even a complex group of signals, with 40 different shapes, wasn’t as effective. [Simply making the signals more complex doesn’t make them more effective. It’s much more important that the magnetic signal integrates with the brain’s own electrical signals, making its “shape” more important than the strength of the field that carries it.]

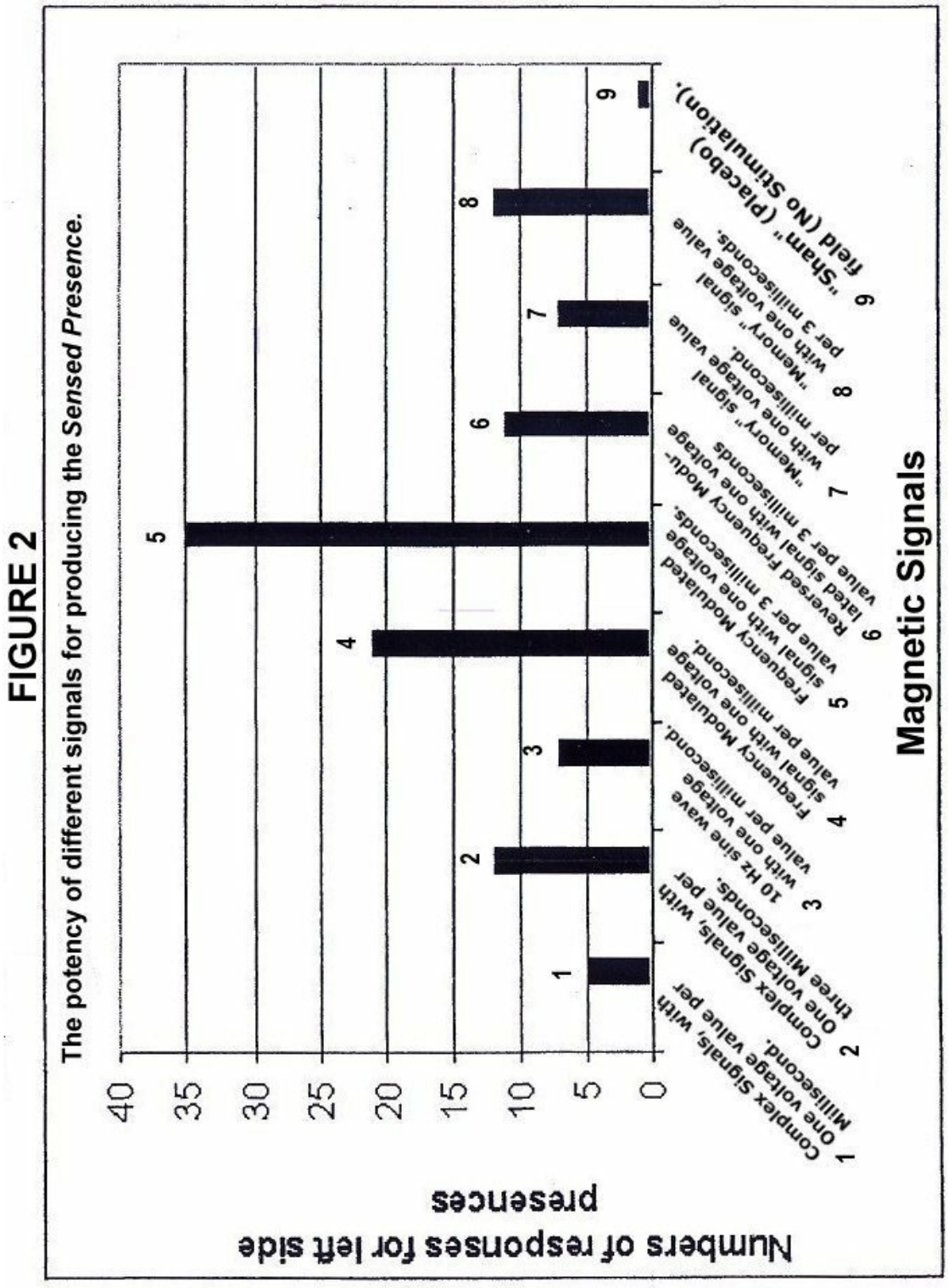


FIGURE 2
The potency of different signals for producing the Sensed Presence.
Numbers of responses for left side
presences
0
5
10
15
20
25
30
35
40
1
2
3
4
5
6
7
8
9
1 Complex Signals, with One voltage value per Millisecond.
2 Complex Signals, with One voltage value per three Milliseconds.
3 10 Hz sine wave with one voltage value per millisecond.
4 Frequency Modulated signal with one voltage value per millisecond.
5 Frequency Modulated signal with one voltage value per 3 milliseconds.
6 Reversed Frequency Modulated signal with one voltage value per 3 milliseconds.
7 "Memory" signal with one voltage value per millisecond.
8 "Memory" signal with one voltage value per 3 milliseconds.
9 "Sham" (placebo) field (No Stimulation).
Magnetic Signals

This graph (Figure 2) shows how some signals are much more effective than others for producing the sense of a presence on the *left* side of the person. The amygdala burst-firing signal (not shown) is the most effective overall. The placebo (no field) was the least effective.

Experiences outside the Laboratory

We've gathered data from questionnaires of temporal lobe experiences filled out by 1,500 students over 15 years. We found that the spontaneous experience of the sensed presence in daily life tends to happen for people who have other, similar experiences. They're also more likely to have mystic experiences such as "being visited late at night by a cosmic consciousness" or moments of being "at one with the universe." [This phrase can refer to several different experiences and states of consciousness]. We have called the source of both kinds of altered state experiences the "Muse" factor. Other such spiritual experiences include feeling "intense meaning from reading poetry and (spiritual or romantic) prose" or feeling that one's thoughts are so important that they have to be written down. Other examples include vestibular sensations and experiences of low-frequency waves running through one's body in twilight sleep, or "hearing one's name called just before falling asleep."

As part of our work both with normal people and brain injury patients, we've collected information from more than 500 patients who had been through traumatic injuries. Most of these didn't lose consciousness, or exhibit any *verified* brain injuries. More than half of these patients told us that they began to feel a sensed presence soon after the injury. In every case, these patients also felt that they were no longer the same person they were before their head trauma.

These experiences were so powerful and unpleasant that most of the patients hadn't told their doctors or family members about them because they were afraid they'd be called "crazy." In general, if the presence appeared on the left side most often, the experience was unpleasant. These patients often had anxiety attacks and feelings of apprehensiveness appearing along with the sensed presence experience. If the presence mostly appeared mostly on the patient's right side, the experience was either neutral or positive. In these cases, the patients frequently mentioned that they received "inner" messages, which they interpreted as perceiving the thoughts coming from the "being" or simply "just knowing" things, [without always knowing where the information was coming from].

The negative presences were most commonly interpreted as ghosts, demons, devils, or other malevolent beings; cultural icons that represent evil.

In contrast, positive experiences were explained as the presence of deceased loved ones, like spouses and parents, or even angels or God. They were believed to be “good” beings. These “angelic” beings often reduced the person’s anxiety.

We also found the sensed presence happens more often between midnight and 6:00 am, especially between 2:00 and 4:00 am (local time). This peak is also the time when temporal lobe seizures are most common. We saw this in our patients as well as reports from in the 19th century, before effective antiepileptic medications were developed.

Because these are essentially electrical events in the brain, it comes as no surprise that, when the earth’s magnetic field becomes more active, there’s an increase in “apparitions” and ”visitor” experiences (*visual* sensed presences), as well as the kind of epileptic seizures that begin in the limbic system. To test this in one of our studies, we did an experiment where we produced seizures in epileptic lab rats by applying a magnetic field carrying signals that commonly appear during geomagnetic storms.

Geomagnetic activity can encourage electrical sensitivity in the limbic system. When geomagnetic activity reaches higher levels (above 20 nanotesla), the amount of melatonin goes down. Melatonin can mute electrical activity in the hippocampus, a structure that’s heavily implicated in dream imagery. Reducing nighttime melatonin levels, especially in the hippocampus, can increase the chances for spontaneous altered state experiences at night. We’ve been able to lower melatonin levels in rats by applying magnetic signals at night, when melatonin levels would ordinarily be increasing.

Personality Changes and God experiences

A first-hand experience of God can create changes in the temporal lobes and the limbic system, which are particularly sensitive to these changes, and these changes invariably alter people’s personalities. When the limbic system undergoes changes, so does personality. New synapses often form in specific areas of the hippocampus (and the tissues that surround it), and this can have a strong influence on the way we think. These new synapses even contribute to seizures in people with temporal lobe epilepsy. [Similar changes in the

amygdala alter people's emotions, making them prone to bursts of anxiety or joy, and changing their default emotional responses (their "affective style")].

Some parts of the hippocampus [which is involved in inner imagery of any kind, including memories and dreams, as well as meditation and trance] are extremely sensitive to brief chemical and physical traumas. One of them has very strong responses to reduced oxygen, high stress levels, or reduced blood supply. The hippocampus also has an unusual layout for its veins and arteries that makes it more vulnerable to circulatory problems than other parts of the brain. Geriatric patients show EEG signs of [faint] seizure activity in the temporal lobes more often than others, so we can understand why older people tend to report more religious and spiritual experiences.

Sudden and unexpected brain trauma, [like concussions] can also alter the brain, and create personality changes. Near-death experiences, which can happen when a dying person's limbic system lacks enough oxygen or glucose, are often followed by [dramatic] personality changes. Such people can find themselves emphasizing the spiritual side of their lives. They often say that they've lost their fear of death and let go of any anxiety about the purpose of their lives.

Two researchers, Bear and Fedio, have described the personality changes that appear in people with temporal lobe epilepsy. Other researchers have described how these patients maintained their intelligence and ability to interact with people, in spite of their seizures. They often talked about their powerful mystic experiences, many with striking visual hallucinations, as well as their profound beliefs.

Those who've had brain injuries that affected the temporal lobes have a great deal in common with those who have spiritual experiences as well as some temporal lobe epilepsy patients. Other researchers have found that a "God experience" [in both epilepsy and in the lives of saints] often involves powerful dreamlike episodes, strong feelings of movement, like being "uplifted", or the sensation that "a burden" has been removed. Such mystic experiences can also include the sensation of "sudden knowing," or hearing messages from higher beings, and the feeling that their revelations are very important for them ("intense personal meaningfulness").

A person can find they are confused and disoriented when a mystic experience is over. They may feel that they have lost some time, show a partial amnesia, and they may weave some of the thoughts and feelings that come after the episode into their memory of it. They can be very selective about who they confide in, but still seek out people [such as a priest, another mystic, or a spiritual teacher] they can talk to about it. One of the most common explanations for these experiences is that the person was “called by God.” The specific name for God, of course, as well as ”his” attributes, and the religious teachings it conveys, vary from one culture to the next. [A Hindu spiritual guide might advise that the person take on meditation practices or spiritual disciplines that discourage anger, fear, or desires. In contrast, Catholic teachers might advise prayer, taking the sacraments and service to the poor. Evangelical Christians would encourage fellowship, Bible study, prayer, “witnessing” and baptism].

In the end, personality changes almost invariably follow mystic experiences, which like seizures, “edit” pathways in the limbic system and the temporal lobes [”pruning” away inhibitory synapses], making them more responsive. [These changes are often interpreted as “being touched by God,” being “awakened” or as “opening” to one’s “true self”. Dramatic neural events, like seizures, head injuries, and near-death experiences make changes in the brain primarily by overwhelming *inhibitory* synapses, and causing them to “drop out” more than excitatory synapses. The language of mysticism often speaks of spiritual growth, whether through slow and steady progress or through sudden epiphanies. They very often refer to achieving “higher states” of meditation or communion with God as a loss of inhibitions. A person’s self-importance is disinhibited when they “get out of their own way”. Someone might become closer to God, and feel that they have “stopped resisting.” Meditation progress is seen as losing the inhibitions to awareness, focus, and relaxation. Active mystics strive to lose their inhibitions against the object of their quest, whether it’s the self within, or the divine without. The language of neuroscience and the language of mysticism agree. Our own inhibitions, which repress surrender to God or perception of the “true self”, are the primary obstacle mystic progress]. There can be moments of automatic behavior. The sense of self seems to “expand” so that they are more connected to the world around them, which has more impact

on their senses and emotions. The person may begin to feel that what they're going through, in both their life experiences and moment to moment, is happening because they were "selected" for one of "God's missions on earth" [or that their destiny, selected by their karma, is coming to fruition]. A trait called "viscosity" ["resistance to change in flow"] may appear, where the person may seem to be "stuck" on specific ideas or even just phrases. They may begin to see meaningful patterns in unrelated events, as their emotional life becomes wider [as their "minds and hearts open"]. They may also rely on their intuition instead of reason or concrete facts. Such people are also likely to focus on philosophical, metaphysical, or religious ideas, and can find themselves compelled to record their thoughts and feelings [in journals, diaries, or blogs, acting out a trait called "hypergraphia"].

In addition, the person, feeling that they have a "cosmic mission," may be driven to proselytize, "spread the word" or "share their vision" with others. Their social circle changes as they become drawn to people who share their beliefs, aspirations, and "vision." The person is now "different", "reborn," "awakened," or feels that they have been given a new "path." Even though these changes may reshape their personality, they still interact with others normally and retain their intelligence.

Historical Examples

Many religions have evolved around individuals who appear to have been through powerful enhancements of their temporal lobe's functions. Their mystic experiences happened in caves (Mohammed) [عليه السلام], during social isolation in the wilderness (Christ), or in the sensory deprivation meditation and yogic practices provides (The Buddha). Each of them was convinced that they had found the spiritual truth about the universe they lived in, and each began religious traditions that influenced the development of later civilizations.

In the 15th century, Guru Nanak, a musician who was out of work at the time, went for his daily bath in a nearby river and then disappeared for about three days. When he came back, he kept silent for a day and then said, "There is neither Hindu nor Muslim. I will follow God's path." The Sikh religion grew out of his revelations. Today, skeptics might see a case like this as

being not unlike an “alien abduction” experience.

In the 19th century, a young man, the son of a minister was walking in the forest where he felt a presence. He began to receive information from a “being,” which stayed with him persistently. He felt compelled to record these inspirations from a “messenger of God” [the angel Moroni]. [Other revelations followed, including the discovery of a Scripture inscribed on gold plates, which the same angel helped him to translate.] This was the beginning of the Mormon Church of Latter Day Saints.

The experience of God offers some of the most profound feelings human beings can experience. Dostoyevsky wrote about his seizural epiphanies, saying, “The air was filled with a big noise and I thought it had engulfed me. I have really touched God. He came into me, myself; yes, God exists. I cried and I don’t remember anything else. All of you healthy people can’t imagine the happiness we epileptics field during the seconds before our attacks. I don’t know if this felicity lasts for seconds, hours, or months, but believe me, for all the joys that life brings, I would not exchange this one.”

[The editor’s book: “*Sacred Pathways: the Brain’s Role in Religious and Mystic Experiences*” has a chapter on the subject that examines stories from several other mystics. These include Thomas Merton, Adm. Byrd, R. Buckminster Fuller, St. Seraphim of Sarov, Ramana Maharishi, Eckardt Tolle, Osho, Malcolm X, St. John of the Cross, Bill W, one of the founders of Alcoholics Anonymous, and several others. Interested readers can search for it on Amazon.com]

However, these experiences aren’t always harmless. In one 19th century case, a temporal lobe epileptic told his doctor: “God told me that in my next life I would be born (with the initials) C.H.S. And marrying my last sweetheart, be a millionaire, and that I would be (a) strong, hopeful, and powerful Christian millionaire. I feel God’s voice in my left ear at night. I feel the Lord in my chest. I see stars in my eyes. I have seen Christ crucified. God told me I would never have any more fits. God told me to bite off a patient’s ear. If God told me to do wrong it feels as if I would do it.” [Another, possibly more telling case, is that of Roch Thériault, a Canadian cult leader who showed several signs of temporal lobe sensitivity (including

multiple religious conversions, and personal revelations from God). He founded a cult where members were even brutal punishments for minor failings, and eventually came to be regarded as one of the worst criminals in Canada's history.]

Belief in God as a 'Cognitive Virus'

Cultures have been defined as communities of people who share expectations. These beliefs make the world we experience seem understandable. They allow us to make predictions about the future and to reduce our fear of the unknown, with its anticipation of terror and deep fears of things we often can't imagine.

Even though we habitually suppress it, perhaps the one thought that's most responsible for maintaining belief in God is the simple sentence "I will die". Although our species has devised three ways to defuse this linguistic time-bomb, it goes off when we think that our demise is immediate and inescapable.

The first and most common way we avoid the thought that we're going to die is to remove the expectation that we'll cease to exist when it happens. Every human society or religion has a word or idea that alludes to infinity, omnipresence, and eternity, and to some extent, imposes these qualities on human beings, even if only in special circumstances. If something is eternal, it cannot end. If we never end, then there's no need to be anxious about death.

To accomplish this; humans have come to see ourselves as part of the "infinite." Sayings like "I'm blessed with eternal life because I have faith in God" or "I will live on with God," "life everlasting" or "I will soon be reborn" effectively reduce anxiety, if we believe that God or consciousness is eternal. The "self" looks like it can never die, because it endures forever [having always been a part of the divine].

The idea the self is more than the body may derive from the simple observation that one's mind and body can behave separately, as they do while we're asleep. Our bodies may not move at all, even though our minds are occupied with our dreams,.

This division of mind and body encourages the concept of the soul, which, like our minds while we're having dreams, appears to exist independently of our bodies, [and so death looks like nothing more than "falling asleep."].

The belief in God can never be refuted or tested. God is always believed to be "nonphysical," and beyond all measurement. Invoking God and "his" will provides a "last resort" for questions that can't be answered any other way. Faith, a religious idea that implies strong belief [or the "feeling" that something is true], is itself used to prove the validity of belief in God. When challenged, religious believers often demand that the challenger should prove that God *doesn't* exist.

Science can't prove a negative, but this limit isn't a weakness in scientific method. We can also think of it as encouragement for scientists to consider unending possibilities, so long as measurement can be attempted. The existence of God can't be refuted, and scientific method can't prove that "He" doesn't exist. No one could believe that the universe is governed by invisible, nonmaterial pink elephants, but no one can prove that they aren't there, either.

Another way of resolving the mental dilemma of one's own death has been to deny the existence of the self that will one day die. Several Eastern religions teach that the "self" is an illusion, supported by our use of language and the beliefs of our cultures. In this way, the "path to truth" is to suppress language [quieting the "monkey mind"], and focusing on what remains when words are replaced by silence. Another belief, inspired by Eastern religions, is that the self is only a part of a larger "cosmic whole," which has no end in time or in space ["*Atman* is *Brahman*"].

The third way to defeat the thought that "I will die," is to replace the word "will" with a word in the present tense, like "I am dying," ["he who was not busy being born is busy dying."] Because this way of thinking about death involves translating it to the present, there's no reason to fear the future. It always already exists in the "now". The discomfort of the present moment doesn't include the fear and anxiety that appears when we expect a threat in the future. ["O death, where is thy sting?"].

We can see that belief in God and religion offered us survival advantages during our evolutionary history. If they hadn't helped us to survive, these behaviors would have been "pruned" out of the repertoire of common human activities a long time ago. If they were bad for our survival, they would have been deleted from the human repertoire of memes, or perhaps even our gene pool [if they have a genetic basis]. [In addition, we should remember that religious beliefs encompass much more than just belief in God. They contain guidance, however useful or useless, for many types of human behavior. Religious morality can become [especially after it was codified in Scriptures] a repository for a wide range of beneficial commands and suggestions, which pushed our behavior towards adaptivity. Religious injunctions to avoid killing or harming members of your own community, as well as respect for their possessions, would have once helped human beings live together, especially in our early, tribal, evolutionary history. Commandments demanding that we don't interfere with other people's romantic and sexual relationships could easily help avoid conflicts between people, with their inevitable negative consequences for young children. Religious rules that demand we avoid "blasphemy," would prevent people from interfering with the religious beliefs of others, making it harder to become alienated from their community.]

Our working hypothesis has been that during the first generations of our species, developing our ability to anticipate the future meant that we would also anticipate our own deaths. If we didn't also evolve some way of reducing the anxiety this thought creates, the fragile sense of self in human beings would have been fragmented, [and many behaviors, essential to our survival would have lost their motivations. Why take care of your children, if they're only going to grow up to die? What's the point?] Without religion, our understanding of ourselves would have been dominated by "existential" fear and anxiety, an incapacitating response that could have threatened our survival.

In the present epoch, most people learn at least one of these responses to the threat of personal annihilation during their childhood. Our parents, or other people who take care of us when we're young, give us these ideas to explain how it's possible that pets, grandparents, relatives, or friends die. The

child infers that, if their grandmother's death means that she has gone to be with Jesus, their own death will bring them the same experience, so there's no need to be afraid. The child retains this belief as they grow up, which finds new contexts and greater subtlety each time they go through a stage of their growth. By the time they're adults, and able to question or challenge their own belief in God, it will have been integrated into their "default" thoughts about themselves.

We did an experiment that showed how people avoid questioning the validity of their belief in God. We saw that, even though it's not accompanied by any psychiatric disorder, it has many of the characteristics of a delusion. Many clinicians will recognize how difficult it can be to show a delusional patient that their beliefs aren't reasonable. When you take such a patient one or two logical steps from seeing that their delusion is a falsehood, their thoughts often stop or they're rerouted to another topic.

The experiment was designed to see how people steer away from concluding that one of their beliefs isn't valid. We asked volunteers to respond to a series of connected statements that appeared for five seconds each on a computer screen. They were asked to answer yes or no as quickly as they could. The questions began by saying that the universe is made of matter and energy and gradually moved towards the development of molecules and cells. One item stated, "The neuron is a cell." From that point on, the statements slowly moved toward a conclusion that would falsify their belief in God. The statements were:

The neuron is a cell.

The brain is composed of neurons.

Different interactions produce different behaviors.

All perceptions occur within the brain.

All experiences occur within the brain.

Beliefs are composed of experiences.

Most people believe in the existence of God.

God is a belief.

God is an experience within the brain.

All experiences are produced by the brain.

The experience of God is produced by the brain.

God does not exist except within the brain.

As they began to approach the statement that “God does not exist except within the brain the volunteers, (especially the ones who believed in God and attended their church frequently), took longer to give their response (even after the grammar and length of the statements were taken into account). This began around the statement that “most people believe in the existence of God”. Activity on the right side of the brain increased as they read the statements that approach the conclusion that God is generated within the brain.

This study showed how ordinary people avoided or ignored the conclusion that their belief in God may not be valid. It also suggests that it becomes stronger each time it’s invoked and successfully reduces someone’s anxiety. The belief appears to be a powerful mental anxiety reducer and antidepressant, which responds to challenges to the sense of self.

There is a negative aspect to this “mental opiate.” How do you respond to people believe in a different God? If their beliefs are valid, does your God lose his power and omnipotence? Suppose the God of your belief also says that he’s the only one, and those who believe differently aren’t fully human, and therefore expendable? These questions threaten the (very human) ability to believe in our own immortality, and that we will survive death. Would you kill other people in order to preserve the feeling that you’ll enjoy everlasting life?

“I would kill in God’s name”

Some disorders in the limbic system, especially the amygdala, can trigger aggressive behavior, and sometimes even result in killing other people. Stimuli that lower the threshold for activity between the amygdala and the

hypothalamus (which mediates our body's automatic controls) can occasionally evoke a violent response. The triggers can even be minor, as subtle as a specific smell, hearing a reference to a different religious belief, or a drop in melatonin levels from a geomagnetic storm.

Human beings are one of the most aggressive species that ever existed. Among mammals, we are the Tyrannosaurus Rex. We've killed every kind of animal we've encountered, and driven many species into extinction. The human initial response to new discoveries, from stone tools to nuclear chain reactions, has been to use them to kill a perceived enemy. Around 150 million people have died in wars between nations since about the year 1500.

It's impossible to know how many cultures have been destroyed and pillaged in the names of Jehovah, Allah, or *the creator*. Although historians, anthropologists, and sociologists explain wars in terms of their political and economic origins throughout history, the individual soldiers who did the killing often felt that they had God's consent. When the belief that guides you as a soldier is also the source of the promise that you'll have eternal life, the fear of being killed in battle can seem trivial.

Even though most people would not kill anyone, even if they thought their God condoned it, the percentages of those would is disturbingly high. When first year psychology students were asked to say yes or no to the statement "if God told me to, I would kill in his name," about 7% of them said yes. Interviews with some of the students, after they took the questionnaire, showed that they weren't filling it out at random, or being frivolous with their answers.

25% of adult males who went to a church, synagogue, or mosque frequently said they would kill someone if they thought God wanted them to, while only 9% of the women said the same thing. Looking for predisposing factors, we found that about 50% of the men who said they would kill in God's name also fulfilled three criteria. 1) They attended church frequently. 2) They'd had a religious experience of some kind. 3) They had higher than normal numbers of temporal lobe signs (such as déjà vu, sensing a presence, illusory sensations of movement, or chills while listening to music).

Close examinations of the personality traits and psychological tests of

these people showed that they weren't pathological. We used a very well-known psychological test, the *Minnesota multiphasic personality inventory* (MMPI), with questions based on a psychiatric view of human behavior. We found that their psychiatric profiles were about average, and they certainly weren't much different from the profiles of those who said they wouldn't kill anyone, even if they thought their God wanted them to. When we looked specific psychological traits, like suggestibility how prone they were to imagining things, and levels of self-esteem, we found that the two groups were about the same. The people who said they would kill someone if they thought God wanted them to were, in fact, *normal*.

Many Scriptures, including the Bible, the Koran, the Egyptian Book of the Dead, the Book of Mormon, the Torah, the Puranas, the Popol Vuh, and the Bhagavad-Gita, all mention killing other people as a demonstration of their god's powers, a justification for their existence, or for their appearance on earth in human form. Those who don't belong to a culture's main religion are commonly marginalized as having inferior minds or emotions, and their lives are thought to matter less than those who accept it. Societies that believed they were "the chosen ones", have invaded land belonging to other nations slaughtering entire populations, because they thought that God had given the land to them [e.g. Israel and Palestine, the USA and its "manifest destiny", England and the "white man's burden", "sub-humans" and "living space for Germans." The list goes on.]

To see how normal people might agree with the idea that others should be killed when God wants it, we selected excerpts from major scriptures on this topic. We hid the source and the historical features of these religious passages, by changing some of the words, and replacing God's name with the word "Alien." For example, one excerpt said "if you should die or be killed in the cause of the Alien, the Alien's forgiveness and mercy would surely be better than all the riches. When you die, you will be taken by the Alien into his midst." Another quotation read, "Those who rebel against the Alien listen to the evil forces. They become an enemy of the Alien and all that is right. Therefore the Alien has no place for them in his domain. If you die before you believe in the Alien, you will become conscious of your own guilt, which will fill your being with pain, anguish and unquenchable flames that last

forever."

We gave these items to students in the University with the title "Clinical Rating Exercise". The students were told they were reading comments by delusional psychiatric patients about "receiving special information while they had supposedly been abducted by aliens." The students were also told that the alien's actual name had been changed simply to Alien. Their job was to determine which of the patients were most dangerous because of their beliefs about their own death or how they saw their own mortality. The students were also told that their job was to "protect society from dangerous offenders." The students checking the answers were asked to rate each original comment from the scriptural source (which they had been told was a psychiatric patient) on a scale between one (no danger) and seven (very dangerous).

The most obvious result from this experiment was that the students who had extreme religious beliefs didn't think there was any danger to society in having someone believe that if they "were killed in the cause of the Alien, it's forgiveness and mercy will be better than all the riches." These results did not reflect any specific religion; they appeared for people of many different faiths. Rather, this result reflected the intensity, fundamentalism, or orthodoxy of their beliefs. The same subjects also said "yes" to statements like "there are things science should not investigate" or "belief in science and religion are not compatible."

When these same statements were quoted in the original, and we revealed that the "alien" statements came from scriptural sources, they were seen as less dangerous. We don't know if this is because today's culture encourages respect for all religions equally, or because of the common expectation that religion can only be positive.

Implications

The outcome of our research, as well as results from other scientists, leads us to believe that our beliefs about the gods, as well as the direct experience of their presence, and even intense epiphanies, are normal experiences and are natural, if recondite (subtle or hidden) brain processes. Very likely, they developed in human beings along with other changes in our

brains and minds that make it easier for us to adapt, survive, and achieve social success. The first role of religious beliefs could have been reducing fear of our own deaths, which if it were left unchecked, could have made it harder for us to adapt. [The various theologies and religions, including those that came later in history, may have codified socially adaptive behavior, contributing to the survival of our earliest societies, in spite of their abuse of specific individuals].

There is now laboratory evidence that we can simulate the sensation of God's presence and less commonly, visions of God. Although we have found ways of applying magnetic signals that can trigger these experiences, it seems likely that some people will need variations on the procedure in order to achieve the optimal effect. We could compare it to a clinical psychologist choosing antidepressants, and the ideal dosage for each patient. [It's also possible that more elaborate or sophisticated stimulation procedures will allow even more robust responses.]

The brain structures that evoke the experience of God also play a role in sexual behavior and aggression. Because of this, the combination of experiences of God and certain religious beliefs can make it easy for some to become aggressive towards those who don't share their beliefs, especially if they believe that God had instructed them personally (a "private revelation"). This can also happen with some temporal lobe epileptics. Humans are a social species, and with only a few exceptions, we need to be close to others and to have a place in our social group. Unfortunately, one of the consequences of our social nature is that it can create tendency to exclude people who "don't belong," especially when they seem to threaten or even just disrespect the validity of the group's beliefs.

The experiences of God that nurture religious beliefs can be provoked in many ways. Some of them may still be waiting to be discovered and these discoveries could reveal phenomena even greater than the experience of God or belief in him. The idea of circles attached to other circles ("epicycles") to explain the motion of the planets faded away when astronomers realized the planets moved around the sun and not the earth. The idea that diseases were caused by "foul vapors" collapsed in favor of the infectious disease theory. Similarly, the belief that experiences of nonphysical beings are proof of other

realms or dimensions will become superfluous. These kinds of changes have occurred all through the history of scientific discovery and advancement.

Now there is potential for a technology that could be used to amplify the experiences of nonphysical sentient beings in large numbers of people without their knowing it. The magnetic signals we've explored, derived from organic brain activity, could be partially broadcast over long distances. Like all technologies, it could be used for everyone, or only for the benefit of a few. This technology influences the core experiences that support the belief in immortality. Understanding the brain's roles in the experience of God and in our religious beliefs, as well as how this compelling event it can be triggered or prevented, may be crucial for the survival of our species.

CHAPTER THREE

The Neuropsychiatry of Paranormal Experiences

(*Journal of neuropsychiatry and clinical neuroscience*: 13: 515-524, November 2001)

Science must confine itself to the facts, observations, theories, and hypotheses of the scientific community. From that perspective, all behaviors and all experiences begin as electric and magnetic events within the human brain. This includes paranormal experiences. These experiences often include the sense of a presence, and appear to involve information from outside our normal senses, including our perception of time.

Most paranormal experiences have emotionally negative themes and emphasize some aspect of death, whether our own death or that of others. These experiences are more common at night, especially between 2 and 4 a.m. The sensed presence experience is also more common at this time of night. Temporal lobe seizures are also more common at this time of night, and this suggests that temporal lobe seizures and paranormal experiences are both based on the same mechanisms in the brain.

If mental forms follow neural functions, then different kinds of

experiences will be associated with specific brain parts or patterns of activity in specific neural regions. Paranormal experiences are associated with certain brain areas, and types of activity in the temporal lobes. The fact that these are connected doesn't prove that the experiences are "true". It only suggests that activity in the temporal lobes and nearby brain parts are associated with the experiences and may involve either normal temporal lobe activity or a more chaotic kind. They could reflect information from outside the brain, being handled by yet undiscovered neural mechanisms.

[This article was published in 2001, and since then, Dr. Persinger discovered some of the neural mechanisms he mentions here. See his articles on the “Octopus” (circumcerebral) experiments.]

People with temporal lobe epilepsy, especially those whose seizures that began in the amygdala and hippocampus, have paranormal experiences more frequently than most, and this is been known for decades. Time distortions, sensing the presence of a conscious being, out-of-body experiences, and even religious experiences have occurred during temporal lobe seizures. Similar experiences appeared during surgery when these brain parts were stimulated directly using electrodes, especially in the right hemisphere. These experiences are not memories. Instead, they seem to amplify whatever experiences (memories, thoughts and perceptions) the person had just before the stimulation began.

There seems to be a spectrum of temporal lobe sensitivity, and everyone has a place on it. Normal individuals who don’t have temporal lobe epilepsy, but are very sensitive to altered states and hold tightly to religious beliefs, report more types of paranormal experiences, and they have them more often than others. These people also show unique patterns as displayed in EEG, and they have higher scores for unusual ways of thinking and are more likely to have a mild form of mania, marked by elation and hyperactivity, called *hypomania*.

Normal people who have more temporal lobe experiences also have many of the personality traits that appear in temporal lobe epilepsy, with different variations on the themes. Their perceptions may seem quite meaningful, because the amygdala is involved in the experience of *meaningfulness*, and this gives them experiences of deep and even cosmic meaning more often than most, especially in response to fear or unusual events. One common theme is that the person has been chosen by a higher force, or has a particular

purpose in life and must spread a message to the world at large. The sense of deep meaningfulness for paranormal events is a predictable contribution from an unusually sensitive limbic system. Of course, this extra sense of meaning is more common with unusual experiences than it is with common ones. The daily grind of work and "taking care of business" can seem like a petty and irritating distraction from the real business of answering "the call".

In general, spiritual beliefs and spiritual experiences (including paranormal ones) are connected to each other. The more spiritual or paranormal experiences a person has, the more spiritual beliefs they will hold. Our ordinary beliefs and expectations may shape our experiences, but they do so lightly. In contrast, our experiences have a very strong influence on our beliefs. "Seeing is believing"; even when what we see comes from within our minds. Paranormal beliefs seem to drive out traditional beliefs easily, and even act as substitutes. People who believe that UFOs are evidence of extraterrestrial intelligence or believe in reincarnation are less likely to hold more common beliefs like original sin, or heaven and hell, and they’re a lot less likely to be willing to "kill in God's name".

Geomagnetic Activity and Paranormal Experiences

One of the first observations that suggested that paranormal experiences could be explained in other ways besides invoking nonphysical "energy beings" was that geomagnetic activity and apparitions of the dead were connected. Bereavement apparitions (visions of those who have died) are most common in the first three days after the person had died. The most likely time of day for these experiences is when someone would ordinarily be asleep and having dreams. The increase in geomagnetic activity in the earth’s magnetic field associated with these visions is quite small, about 1% of the total. These changes usually take several minutes to happen, but in some instances they can peak in as little as four minutes. Nevertheless, the impact is enough that they can serve to predict sleep disruption for sensitive people, and this is useful for explaining changes in psychiatric symptoms. The connection between activity in the geomagnetic field and sleep disruption has been seen since the 1930s. At one time, this information was only available from a few sources like the *US national geophysical data center*. Today, it’s available online to anyone.

Epileptic seizures happen more often when geomagnetic activity goes past a certain point. We exposed laboratory rats, specifically bred to have

epilepsy, to magnetic fields that fluctuate like geomagnetic activity for two hours, and they had seizures more often, too.

Magnetic fields with fluctuating strengths decrease normal nighttime melatonin levels and increase the amount of a brain chemical (a *neuropeptide*) that facilitates seizures. Taking all this into account, we developed the hypothesis that the early morning hours are the most likely time for both bereavement apparitions (seeing the ghost of a person who died recently) and sensed presence experiences because the thresholds for limbic system excitement are lower at that time, especially during dream sleep. However, instead of ordinary seizures, the person experiences (especially when they wake up suddenly) the sensed presence or some kind of "visitor." The experience may be provoked by a variety of external events and depend on how prone one is to altered state experiences overall.

[The reader should take note that altered state experiences are considered as examples of low-level or *subclinical* temporal lobe seizures. 'Subclinical' means that they consist of some of the same experiences, but without the person actually being epileptic or ever having had a seizure.]

Experimental Simulation of the Sensed Presence

Since about 1986, our research group has looked at the neurological and physiological contributions to the sense of self and to the phenomena of consciousness. They reasoned that to study such complicated experiences in a laboratory; we would need a technology that could make changes to them. We saw that applying very complicated, weak magnetic fields had the potential to interact with the very subtle but very complicated electrical and magnetic processes in the brain associated with consciousness and the many subtle processes that compose the human experience.

Magnetic signals with very low strengths and frequencies (similar to the force of magnetic fields around devices from hair dryers to computer screens) and complicated patterns (mostly derived from EEG traces), were applied to the temporal and parietal regions of the brain.

[The temporal lobes are above the ears, and the parietal lobes are where your horns would be if you were a cow.]

We chose magnetic fields because they can reach into the brain’s tissue (you can’t block a magnetic field – it’s against the laws of physics). Let me offer a simple metaphor for these signals and the magnetic fields that carry

them. A simple tone can’t tell you anything, even if it’s very loud, but a faint voice saying "help me" carries a lot of information. The words in a sound are much more important than how loud it is. In the same way, the *information* in our magnetic signals is much more important than how strong they are. Of course, they can’t be too weak or too strong, just as you have to *hear* a voice saying, “help me,” and it can’t be so loud that it completely overwhelms your hearing, or so quiet that you can’t hear it at all.

Our first interests were to discover the brain's role in 1) creativity and 2) the sense of self. Questionnaires that measured creativity and analyzed people’s preferred vocations showed that creativity and a certain type of egocentricity had a lot in common. They both had high scores for temporal lobe sensitivity. [They were prone to common altered-state experiences like déjà vu, sensing presences, feeling like they were moving while they were falling asleep, or tingly sensations from music.] The subjects who took the questionnaires included musicians, writers, artists, and creative ‘thinkers;’ people who saw new connections between things that others didn't think were very interesting.

We found that when we applied two specific magnetic signals over the right hemisphere, most normal people (who didn't know the purpose of the experiment) sensed a presence or felt they were in the presence of a conscious being. Many of them actually felt that this presence interacted with their thinking (as though they were in telepathic communication with it) and it changed its location when they "focused their thoughts" on it. The strengths of these fields were between 10 and 100 milligauss. Many experiments demonstrated and then reinforced that the shape of the field (as it changed every few milliseconds) was responsible for these experiences. [The intensity or field strength was much less important, so long as it was in the right range.]

These studies showed that the sense of a presence, a phenomenon at the core of paranormal and religious and mystic experiences, could be created in laboratory experiments. The experience was most common during or just after stimulation of the right hemisphere. This supported (but did not prove absolutely) that the sense of a presence can be explained as the sense of self in the left hemispheric becoming aware of the "self" that originates in the right side of the brain. Other researchers have suggested that the sense of self, as humans experience it, is an outcropping of the human ability to use

language, and that this is one of the reasons why cognitive or "talk" therapies can have such a powerful effect. The simple process of talking to another person about things that impact deeply on someone can be enough to make them feel that they've become a "new person". The sense that one is no longer the same person they were before either effective therapy or a traumatic event offers intuitive evidence that the sense of self is much more flexible than people often realize. [Words can have a powerful effect. [A simple sentence, like "it's a girl!" can be so powerful that a person's life can be divided into events that happened before it was spoken, and events that happened afterward.]

The sense of a presence could be created for most individuals in these experiments, but it was strongest in people who had higher temporal lobe sensitivity, or were more sensitive to altered states of consciousness. The experience appeared most easily using a "chirp" signal applied over the right hemisphere for 20 minutes, followed by 20 minutes of a signal designed to duplicate burst firing in the amygdala, applied over the temporal lobes. [This information is found in several of Persinger's papers, and hence, is repeated in this book.] These experiences also appeared for dozens of reporters who worked with television crews visiting the laboratory from the 1990s to the first years of the 21st century. The right side of the brain is a bit more sensitive to complex magnetic fields, even very faint ones, than the left, and this is been shown repeatedly by researchers in other laboratories.

These experiments also suggested that the sense of a presence was only one of a much larger class of experiences ["visitor experiences"] that include spirit visitors, alien abductions, creative muses, succubi, incubi, angels and demons, "the muse,' and even the experience of God. Many of these experiences happen during dreaming sleep, when the brain's activity shifts towards the limbic system as it works to consolidate our memories during dreams. These experiences are more likely to happen while a person is awake after the kind of right hemispheric excitement created by singing or chanting in large groups, meditation, prayer, trance dancing, and a wide range of other spiritual techniques. Religious rites that don't encourage excitement in the right hemisphere would tend to be forgotten by the cultures that produced them, while those ceremonies and rituals that create the right ['trance-like'] conditions for these experiences would be more likely to be remembered, preserved, and repeated. The sensed presence has been given a wide range of other names in the world's traditional religions, and the name given to it in a

specific cultural or religion will tend to shape the expectations of people who have it and this will have a strong effect on the details of their memories of it. There are also variations on the theme from one person to the next within each society, religion or congregation. In this way, the experience of a single sensed presence [or range of experiences] can express itself in many different ways, adding variety to each human culture.

Haunts and Presences as Evoked Experiences

Paranormal experiences commonly happen in specific places. They tend to appear along with a sense of a presence, fear, strange smells, apparitions at the edge of the visual field (usually the left side), that vanish when someone tries to look at them directly, and sometimes even noises. When we monitored these places for magnetic activity, they usually turn out to have bursts of low-frequency magnetic fields, sounds or other factors above the range of human hearing, which can affect objects as well as the human brain. Because the people who experience these poltergeists usually don’t know where they're coming from, they're explained as demons, ghosts, aliens, and spirits. Most of the people who came to our lab looking for help with these experiences found them unpleasant or frightening [sometimes terrifying].

Our research group has reproduced these experiences with normal people who had previously seen, felt, or heard ghosts by stimulating the brain with specific magnetic signals. In one case, a middle-aged man who had experienced a ghost in his home reported brief "rushes" of fear a few minutes after a "chirp" signal was applied over the right temporal lobe, while sitting in a [completely] silent and dark [vibration-proof] room. Each of these bursts of fear also created a unique EEG output from the temporal lobe. Towards the end of his session, he re-experienced the presence of his ghost, along with the same fear he felt at home. Other magnetic fields didn’t invoke his ghost experience, (even though they were applied with the same field strength).

Our homes are becoming more and more technological, and have ever greater numbers of electronic devices, so these experiences may be more common than people realize. In one case, a young couple, with a history of sensitivity to altered states of consciousness, awoke suddenly between two and four o'clock in the morning. The man experienced an “energy being” moving through the bed. Both of them heard breathing and experienced a

sense of its presence. Both of them were in fear. On investigation, it turned out that their house was filled with magnetic fields coming from electronic devices, and there were regular peaks of magnetic fields between 15 and 30 mG. The strongest magnetic fields happened at the same time as they reported these poltergeist experiences. As it turned out, the fields were created by poor grounding in the house.

In another case, involved a teenage girl who'd seen a ghost experienced a presence, felt sexual touching, and had the impression of the outline of a baby over her left shoulder. She'd even been to a psychiatrist. She felt as if she had been chosen, though it wasn't clear what she had been chosen for. We interpreted these experiences as most likely appearing from deep within the temporal lobes on the right side. It turned out that a pulsed magnetic field was coming from an electric clock near her bed. A childhood injury to her left forehead probably left her more sensitive to the subtle stimulation from the electromagnetic field coming from its old-fashioned transformer.

Clinical populations

We think of the sensed presence as the left hemispheric sense of self, perceiving it's right hemispheric counterpart (during moments when the normal communication between them had been disturbed). This has proven very useful in working with patients who've sustained closed head injuries. These are head injuries that don't open or even crack the skull. These injuries can often occur without the person losing consciousness or any immediately noticeable neurological effects, but they can often feel like they've lost their normal sense of self. In other words, after injuries like this, the patient can find that they are no longer the same person that they were before. They grieve for the person they once were and try their best to return to their old identity. When this fails, they can have periods of aggression, frustration, and family conflicts. In the end, they become depressed, and often don't respond to normal antidepressant medications. This can happen months to years after the injury. Interestingly, many of these patients respond to *low* doses of antiepileptic medications.

Most of these patients found themselves having more paranormal experiences than before, including the sense of a presence. The ways they appear reflect activation of the right hemisphere. These experiences create strong emotions, and although they can often be seen clearly, their appearance is diffuse and they're commonly transparent. When you look at

the neurological and psychological profiles for these patients, you see evidence of extra activity in the right hemisphere, especially in the temporal and parietal areas. There are also clear signs of unusual activity in the hippocampus and the amygdala. The presence can be so real that these patients think they're going crazy, and often won't talk about them. However, if a neurologist or psychologist can accurately predict some of the details of what they're experiencing, that will often earn enough of their trust to start revealing the full extent of their experiences. It's not at all unusual for them to burst into tears while telling their stories. There is no sign that these patients have their experiences because of suggestibility or the influence of their own expectations.

When the sensed presence appears on the person's left side, it's usually very frightening. These moments can be so bad that the patient may be afraid to go to sleep because they're afraid they won't wake up. These patients are likely to find themselves thinking about suicide. In contrast, sensed presence experiences on the *right* side are usually pleasant or blissful, and are often thought to be the spirit of someone they knew who had died. They can also create the belief that the presence is an angel, Christ, or another being they know from their religion. One technique for helping such people cope is to explain the sensed presence is actually coming from within the person's own brain, without offering any challenge to their private, inner religious beliefs. These beliefs are often created by the person, taking from religious tradition and adding their own explanations of their experiences. When these people find that these experiences, which they can feel are "tearing them apart" come from within their own brains, and don't mean that the devil is out to get them, or that God is angry with them, or that they have been chosen for a mission they feel powerless to fulfill, they're usually deeply relieved.

Cutting down or stopping *unpleasant* sensed presence experiences usually involve things that activate the left side of the brain. These patients can awake suddenly in the night and find themselves in the company of a negative presence [e.g. a monster under the bed, a ghost in the room, or a demon, or even just sounds that one *imagines* come from a malevolent being]. We've found that they can stop it by turning on a special clock that announces the time, and plays some kind of positive message. The patient will already know that these experiences are most likely between two and four o'clock in the morning. When they turn on the clock, and it says that it's a few minutes after 3 a.m., they remember that this is the typical time of night

for such things to happen. This reminds them that the experience is coming from their own brain. The positive message that the clock plays activates their language centers from without, reducing the power of the experience that’s coming from within. [This may explain why so many religions teach that we should invoke the name of the lord to dispel frightening entity. Say a Hail Mary, Recite Hare Krishna, Call out to the Buddha of the Clear Land. “The Lord is my shepherd …”

These kinds of invocations also excite the primary language centers on the left side of the brain.] An even more effective technique has been to bring the person into our laboratory, and use magnetic field stimulation to re-create the being that’s been bothering them. This gives them clear proof that it's coming from within their own minds. Doing this in a "safe" environment helps them to cope, and not to take the experience very seriously. Clinical trials showed that 30 minute sessions with magnetic signals, given once a week, reduced their depression and cut down their thoughts of suicide. Although clinical depression usually involves reduced activity in the left frontal lobe, these studies found that when depression appears because of this kind of brain injury, it’s treated more effectively by stimulation over both temporal lobes. [There may have been a deficit in the *left frontal* lobe, but the best response used a stimulation of *both temporal lobes*. It may be that stimulating both sides tends to restore a dynamic equilibrium in the limbic system that was lost when their brains were injured.]

Experiences of God

Dr. Persinger first saw the characteristic EEG traces that showed epileptic activity from the right temporal lobe of a normal female subject who reported (with a radiant smile) that she had just experienced God's presence. We saw the possibility that the brain's role in this exalted religious experience could be studied using scientific method. Earlier researchers had shown that the experience of God could happen to more people than just those with disorganized schizophrenic minds.

Studying the brain processes that generate the experience of God is among the greatest challenges neuroscience has ever faced. Visions of God that are taken as proof of his objective existence, and these have unfolded into religious beliefs that have spurred wars, witch-hunts, and religious intolerance. They may even have even played an indirect role in the Nazi murder of 6 million Jews. Huge numbers of people have been killed *in the*

service of God for no other reason than that they believed in God differently, or under a different name. If the massive violence and destruction unleashed in human history in “His” name has anything at all to do with the fact that some people have had visions of God, then understanding the factors that contribute to it becomes an important task which the forces of history have placed before the scientific community.

[“Waves” or “Quanta” of Consciousness]

The sensed presence experience seems to be the foundation for all visitor experiences, and it’s certainly the most common one, and they don’t happen in ordinary, normal states of consciousness. Several researchers have offered evidence that consciousness is a property of brain activity that’s repeated or "refreshed" every 20 milliseconds. [Note: this editor has offered the supposition that this brain activity relates to our experience of consciousness, but also ‘binds’ us to our repertoire of *states* of consciousness. Dr. Persinger agreed with this in a conversation, but never published it, possibly because it would have required a separate hypothesis.] Actual measurements of the phenomena have shown that stable activity, measurable using EEG, and affecting the entire surface of the brain, suggests that consciousness occurs in waves, which travel over the brain surface from front to back about once every 20 milliseconds. It’s been called “the binding factor for consciousness.”

We saw a way to make changes in these recurring "quanta" of consciousness. Magnetic fields were produced through eight pairs of magnetic coils, spaced equally around the head. These included coils above the eyes, just in front of and behind the ears, and on each side of the bony ridge at the back of the head. With each of these pairs putting out the signals one by one, we could "rotate" them around the head. Running them counterclockwise (as seen from above the head), it was possible to run the signals "against the current" of these bursts of consciousness on the right side. By moving the signals from one pair to another at the right speed (close to 20 ms), and changing the speed slightly with each movement (so it didn’t *exactly* match the binding factor’s speed), they would collide with it and push back lightly against it, so to speak. [Instead of stopping the flow of consciousness, the stimulation frees a person from the states of consciousness they’re usually bound to, and opens the way for unfamiliar states to appear, as well as phenomena that’s new for the person, including brain-to-brain

(*telepathic*) communication.]

We monitored the brains of subjects who received this stimulation with EEG. We found that the theta band, a range of low frequencies associated with meditation, hypnosis, and trance, was stronger over the whole brain. There were specific effects from the right hemisphere, including changes in their perception of time. Many subjects experienced an "inner blackness" and various forms of imagination. They had to use words usually used to describe religious states and mystic experiences. Feelings of deep calm and pervading harmony were also common experiences. These sessions were done in complete sensory deprivation. That meant total blackness and *absolute*, "acoustic" silence.

Together with our sensed presence studies, these results outline the natural conditions that help people experience contact with an infinite and eternal being, together with a feeling of inner peace, (a sense that is the very opposite of death anxiety). We created these conditions in controlled settings, and tested them out. Our brains can create these experiences when they're exposed to these moving and constantly changing magnetic signals, when they contain the right information, and if that information is complex enough. [In another of his papers, Persinger said that simple frequencies were among the least effective.] These experiences have sources both inside our brains and in the world that surrounds us, so what can create them?

Paranormal Experiences with Potential Validity

Most reports of paranormal experiences are also expressions of changes in the brain activity of the person who has them. They can be triggered by sudden changes in lifestyle, trauma, head injuries, and a range of other sources. There is evidence that some paranormal experiences involve information that usually isn't accessible. We maintain that measurement and analysis of paranormal experiences does more good for neuroscience than dismissing them. If, 150 years ago, someone told you that that you could talk to someone many miles away, you might have thought that they were insane. Today, you can talk on the telephone and be a few thousand miles away from the person you're talking to. The experience is now so ordinary that it's a bit strange even to mention it. The difference is that today, people understand how telephones work. [In the same way, if we know how paranormal experiences happen, we won't think the people who have them are crazy.

However, it isn’t science if we use metaphysical or religious explanations. Let’s remember the old saying in the sciences: “Physics, beware of metaphysics.”]

Experiences About Others

The experiences people usually call telepathy, precognition, or clairvoyance occur most often during dreams or other, similar, states. If there are brain states help us perceive subtle stimuli while we’re dreaming, then the same states also have the potential to perceive the same kinds of information when we’re awake. One of the best-known examples is where someone awakes from a dream "just knowing" that someone close to them has either died or is in a crisis, and later found out that they actually were. Collections of these experiences have been analyzed going back to the late 19th century. We’ve shown that these incidents happened when geomagnetic activity was significantly lower on the days just before or after these episodes. The correlation between them and this specific pattern of geomagnetic activity was significant, but even if the correlation were absolute ("1 to 1", as its called) it wouldn’t mean that the earth's magnetic field had caused these episodes. [Rather, they may have made it more *likely*.]

Attempts to duplicate these experiences in laboratory settings have met with partial success. One such study was designed to see if the content of the subject's dreams, while sleeping in the laboratory, matched the themes in paintings that individuals, some distance from the lab, were viewing at the same time. These paintings had been selected at random, and all of them involved emotionally charged themes. On some nights the match was remarkable, and on others, we saw no similarity at all.

More than 20 years later, the data was analyzed again, and we found that the nights with the greatest match between the themes of the painting and those of the dreams happened when the geomagnetic activity was at its lowest level. The descriptions of the dream and the content of the paintings were compared under double-blind conditions (the people doing the comparisons didn’t know why they were comparing the two written descriptions and the lab workers who worked with them didn’t know, either). The results suggest that these experiences, which have traditionally been

explained in terms of mystical, magical, metaphysical or non-physical processes, are partially controlled by factors at work outside of the brain. This means that we can use scientific methods to explore how our brains can be influenced by those of others, an idea that many scientists refuse to consider.

Special Cases

If *mental forms follow neural functions*, then some people with unusual brain wiring (perhaps because of differences at birth or experiences during childhood), will be capable of behaviors quite different from that of so-called "normals." When brain differences first appear in adulthood, we expect them to relate to some kind of mental disturbance. There is nothing strange in the fact that only a few people could paint like Michelangelo or do math like Einstein. In the same way, there shouldn't be anything strange when people are able to perceive and respond to things that most people can't feel. [For example, some people have 'perfect pitch', and can identify a tone when they hear it. Others are completely 'tone deaf,' while most of can tell when two tones are similar, but can't identify a specific note, like a B-flat, by its sound.] Lots of things can affect our brains. Specific radio frequencies or changes in the earth's magnetic field can affect it. Very few people can feel their influence, and most are unable to respond to them. The few of us who can actually feel very subtle electrical and magnetic phenomena, may be able to pick up the usually hidden, but still meaningful information embedded in them. Such people would appear as psychics. [Of course, they wouldn't *respond* to the magnetic fields. They'd respond to the information embedded in them, because that information means a lot more than the field itself. We don't respond to the paper a letter is written on; we respond to the words in it.]

We have worked with two individuals who are considered to be world-class psychics. The first one was Sean Harribance. Although he is middle-aged now (2001), he sustained two brain injuries, one during childhood and one during his teenage years. Neurological testing found that he has difficulty with actions that involve the right parietal and occipital lobes. He said that he sees fleeting images that relate to the person he's talking to (or a picture of a person he's holding in his hand), usually in the upper left section of his vision. He touches the photos and gathers his information, even when they're face down. The information he gets in his way can be quite general or very

detailed. The accuracy of this information seems to be well past what one would find in a "cold reading".

In one study, three people were asked to bring in 10 photographs of single individuals and their family. Mr. Harribance "read" the pictures without looking at them, and shared his impressions. His readings were typed out and given to the person who provided the pictures without knowing who had done the readings or how the information had appeared. The person read each of the written comments and matched them up with the photo of the person they thought the comments applied to most. The odds against a successful reading would have been 10 to one when randomly taking pictures of 10 different people, and matching them up with 10 different psychic readings. However, in this study, working with this individual, three subjects accurately identified between six and eight out of 10, as confirmed by the people who brought in the photos. In other words, it was seven times more accurate than it would have been through chance alone.

No one knows how exactly how Harribance gleaned this information by touching the backs of photographs [and this editor prefers to let this be unknown rather than dummying up a pseudoscientific metaphysical explanation]. One thing we do know is that the right parietal lobe raised its metabolism (based on how fast it absorbed a *tracer* chemical while he was “viewing” the picture). There were also small increases in EEG activity (in the alpha range) in the right hemisphere, in the area where the occipital and parietal lobes meet, two to four inches above the ear. There was also a small but steady correlation between the accuracy of Harribance’s statements and the amount of alpha rhythm (compared to activity in other frequencies) appearing over both occipital lobes, at the back of the head. [The more accurate Harribance was, the more alpha appeared on his EEG in that area].

Other experiments with Harribance showed a strong sensitivity to stimulation of the right hemisphere using complex magnetic signals, just like people who report paranormal experiences. Harribance believes his experiences come from a spiritual being that’s an ongoing sensed presence for him. The more often he received a magnetic field of this kind over the right hemisphere, the more often he felt the presence of his Spirit familiar. At the same time, there was a temporary increase with about the same strength, which showed that the differences between the functions of the two hemispheres were reduced. Ordinarily, we would have expected the two

hemispheres to show a greater working *difference* from one another during these moments, [so this was an anomaly for him, possibly due to Harribance's childhood head injuries].

He was also sensitive to a signal with a structure or shape that appears on EEG when our brains are creating memories, but when this signal was applied, the accuracy of his readings actually went down. [Focusing on remembering something in the present could interfere with the attention used to perceive something in the present.]

The second exceptional individual we examined was Ingo Swann, an artist who developed his own process of remote viewing. One procedure to test his abilities was very simple. Pictures from magazines were put into envelopes and stored in one room, while Ingo Swann sat in a completely silent chamber (the size of a small room), 20 to 30 meters away. For each trial, one envelope was taken at random from a stack (selected by a person who wasn't involved with the experiment in any other way) and put on a table in the first room, where Swann drew images that related to the sealed photograph in the silent chamber. EEG data was recorded from his brain in these experiments, which lasted several days. More than 20 photographs were used, [and each one was a separate 'trial'].

Other researchers, who had no idea what the experiment was about, compared the pictures with Swann's drawings and the comments about them. They ranked them according to how well the images in the pictures matched the theme and layout of the pictures Swann drew while remote viewing each one. These blind rankings showed a significant congruence between the magazine pictures and Swann's drawings. (*r*'s of about 0.6). However, the most important discovery [the one that gives us a clue as we try to understand the minds and brain of such exceptional people] was that there were 7 Hz EEG 'spikes' coming from the right occipital lobe that correlated with the accuracy of his remote viewing. This uncommon EEG signature only appeared when he was actively doing his remote viewing. Later on, MRI readings from his brain showed unusual signals - ones that would not be expected in a man his age or with his history, in the area where the parietal and occipital lobes meet on the right hemisphere [where your antlers would be if you were a deer], a bit below the surface.

The results with these two psychics seem to break the rules of physics. However, finding that these phenomena are associated with measurable

changes in the brain does not. Many years ago, W.G. Roll suggested that more than half the people who reported poltergeist experiences also seemed to have epileptic temporal lobe seizures. In spite of this, throughout the history of science, most scientists have rejected the idea that paranormal phenomena could be measured.

Brain imaging technology has spread to so many hospitals and clinics, making it reasonably easy for professionals to access it. This could allow further research that might one day let science categorize paranormal experiences according to the measurable differences they create in brain function [instead of how much the person matches the criteria for a psychiatric disorder].

Modern neuroscience tells us that *mental forms follow neural functions*, or perhaps are just strongly correlated with the brain's activity. As the brain, with it's complexity, constant change, and never-ending activity is mapped out and described, some of the subtleties that mark us out as individuals will be quantified, bringing the experiences we've discussed into normal scientific inquiry, even for the most skeptical and conservative scientists. So far, there hasn't been a single type of religious, mystic, paranormal, or psychic experience that can't be explained in terms of known brain functions, and it may be possible that some of these explanations are compatible with some traditional beliefs.

Realizing that these experiences express predictable activities of the working brain will let us see where they come from more clearly, how worthwhile the information they offer can be, and help us tell illusion from truth.

CHAPTER FOUR

The Electromagnetic Induction of Mystical and Altered states within the laboratory.

Persinger, Michael A., Kevin S. Saroka, Stanley A. Koren, and Linda S. St-Pierre. "The electromagnetic induction of mystical and altered states within the laboratory." *Journal of Consciousness Exploration & Research* 1, no. 7 (2010): 808-830.

Summary. All human experiences are processed through the brain. There are substantial differences between the two sides of the brain, both in their organization on the smallest scale, and in their electrical activity. These predict that there are two basic kinds of mystical experiences. The first includes the range of "visitor experiences', from the feeling that there is a conscious entity nearby the person, when no one else is around, to apparitions and even visions of God. The second includes out-of-body experiences (OBEs) and a range of related sensations and states. These have been reported for centuries, and have usually been thought to have cosmic, metaphysical or divine origins. In the 20th century, they were elicited through direct electrical stimulation of the surface of the brain [using electrode pens as part of a surgical procedure for epilepsy that couldn't be treated in any other way]. In this century, the same thing has been done using weak magnetic fields with signals embedded in them that are derived from brain activity. Using this technique, we were also able to map the similarities and differences between activity in the two hemispheres during these experiences, and compare them to their normal functions. Producing and controlling such experiences in the laboratory can help us to understand their intricacies and how they affect the large numbers of people who have them.

Throughout its history, science has gradually come to a new understanding of human experience by observing and quantifying human behaviors, as well as verifying our understanding through scientific experiments. We've learned that some things we believed about both our behavior and our ideas are either illusions, or reflect our perception more than

what we perceive. We cannot assume that the bulk of human behavior is rational. We no longer believe that humans were specially created by God, the same way we no longer think that the earth is the center of the solar system. Each time we come to a better understanding of human behavior, we've replaced it with descriptions that apply the same scientific methods we use to understand the world around us. [Humans are no longer the center of our understanding of human experience. Instead, we've come to realize that we have the same basic chemistry as other species, we evolved through the same kind of natural selection that produced the biological world around us, and we behave, not according to a "divine plan," but rather to our own advantages, both for the social groups we live in, and ourselves as individuals.]

The human sense of self is associated with things like consciousness, self-awareness, morality, decision-making, and our uniquely human way of responding to knowing that we will (all) die one day. All of these have been shown to match up with specific patterns of brain activity. Mystical experiences are apparently a property [or expression] of altered states of consciousness. They often involve feeling an expansiveness in time and space as well as the sense of deep meaning for those who have them. They can change the boundaries of the self, [so that a mystic experience can broaden a person's focus in life to the point where it seems to encompass the whole universe, and even God, including a divine plan, both for the person and the whole world].

Mystic experiences usually involve positive emotions, and they work to reduce the anxiety associated with death [insofar as most mystic experiences leave people feeling very certain that death is not the end, and that they will go on living after it]. This reinforces the states of consciousness that create these experiences. [The person feels that they're sacred, and will often do whatever they can to achieve them again. They become very meaningful, and whatever 'place' the person seems to 'go' during the experience becomes the "true" reality]. The person who has such an experience will also come to feel that either they, or the insights that they achieved during their experience, have a unique and special importance. [People who've had mystic experiences always seem to feel that they have been shown *the truth*.]

There are two fundamental kinds of Mystic experiences. [We see them epitomized in two basic mystic episodes. One of them ("the visitor

experience') involves the experience of a sentient entity close to the person, from exalted apparitions to a vague sense that there is a conscious entity or being present with them. The other involves being in a location outside one's body. [The Indian spiritual teacher Osho came to a similar conclusion, teaching that there were two basic avenues in spirituality; the way of meditation, and the way of prayer]. During such out-of-body experiences, people commonly feel that they've been given access to information that could never be attained while they were in their normal state. These have been a major source of creativity, insight [and spiritual knowledge, sometimes applying on the very grandest scale, encompassing the nature and creation of the universe, as well as the meaning and purpose of human life]. This kind of 'sacred knowledge' often goes beyond a person's actual education and life experience, as well as "the known" for their culture or society. [Once you've been outside your body, your thinking goes out of the box.]

We'd like to point out three reasons why it's important for science to be able to understand and duplicate these experiences. First, they may show us the mechanisms of creativity and problem solving in the brain. Second, the experiences and the knowledge that are attributed to "higher" spiritual beings [such as God, angels, and spirit guides], are sometimes used to try to prove that a person's own beliefs are infallible, because they come from the "higher powers." Such beliefs have been used to subjugate, or even exterminate people who held different beliefs. Third, if mental forms follow neural functions, then technologies whether existing today, or developed in the future, could be used to influence human behavior on a mass scale, without people's awareness or permission. A further reason why science should make the effort to duplicate these experiences lies in the fact that mystic experiences are often followed by substantial increases in the adaptivity ["morality"] of the behavior of people who have them. [Sometimes this kind of revelation can save a chronic alcoholic, and sometimes it can create a fire-and-brimstone preacher who rails against 'sinners'.] In this paper, we'll look at how we developed our laboratory procedures for eliciting mystical experiences, an overview of our results in using them, as well as the ideas that guided us to invent them.

2. Human Brain Structure and Mystical Experiences

If *mental forms* [even the ones that only super-yogis and Kung Fu masters

can feel] *follow neural functions*, even on the smallest scale, then we have to predict that the human brain, with its two hemispheres, should drive two major kinds of mystic states. There are two significant differences between them. Each side of the brain mostly have the same hills and valleys ("sulci and gyri"), and there are about 200 of them. Nevertheless, only four of these have the same shape on both sides of the brain. None of the others are left/right mirror images of one another.

We can also see differences and similarities in the two fundamental states of brain function: dreaming and being awake. The things we experience while we're awake are mostly run through the left hemisphere, with its sequential [one thing at a time] way of processing images, associated with both our inner and spoken words, including thoughts behind them. The left hemisphere handles our perceptions and ideas according to how well they fit with its existing verbal ways of thinking and remembering things. In contrast, our dreams are mostly run through the right hemisphere of the brain [with its "all at once" way of processing events], and its images are organized by their connotations, and the similarities in the emotions they evoke. [To put it a little more simply, the left side of the brain works primarily, but not exclusively, with denotations and words, while the right side of the brain works mostly, but not only, with connotations and images.]

These two cognitive processes usually integrate parts of each other into their normal day-to-day workings. If the left side of the brain starts working during a dream, and the person wakes up, and then talks about it, or even makes a few notes about it, it not only helps the person be aware of what they've dreamt, it also helps them to create lasting memories of it. If a person waits about five minutes before doing this, they may remember only fragmented dream images. If they wait 15 minutes, they may remember nothing at all. Dreaming has been demonstrated to help us learn [especially how to relate to other people], but *remembering* our dreams is not ordinarily part of the process [just as few successful students remember all the questions on their final exams. That's not what the students are there to learn]. The kind of learning that happens in dreams is easy to get to while we're awake [appearing often as insights and simple intuitions], but it can be hard to remember, and may ordinarily be completely confined to the state of consciousness we're in when we're in the REM state ["state dependency"].

In spite of their radical differences, being awake and dreaming show

strong similarities on EEG (electroencephalography). They're both dominated by complicated fast activity that suggests information processing. There are also waves of electromagnetic activity that move over both hemispheres, from front to back, and these are almost identical whether we're awake or dreaming. [We have referred to this activity as "the binding factor for consciousness" in several of our papers]. Neither of these characteristic patterns of brain activity appears during dreamless ("slow wave") or other sleep states. [Most readers know of some other differences between waking and sleeping, including the frequent absence of spoken words and the way some people see things in black and white ("grayscale") in their dreams.]

2.1. Hemispheric Functions and two Primary Mystical States

More than 100 years of data from neurology and psychology, as well as about 30 years of brain monitoring techniques, like EEG, MRI, and PET, as well as SPECT and LORETA have shown and quantified the differences between left and right hemispheric functions. The left side is more involved with sequential and language processes, while the right side is more involved with spatial, emotional, and defensive jobs. These differences can also be seen in two types of learning by association. One, sequential or serial learning, especially through words we hear (always one at a time), and two, simultaneously or parallel (where things happen all at once), especially through the things we see. [We can only speak or listen to one phrase at a time, but we can see many things at once.]

Neither of these ways of learning belongs *only* to one hemisphere. The left hemisphere holds our primary language centers, but the right side of the brain also shows some linguistic ability. Some experiments have shown that the right hemisphere, acting on its own, has the language skills of a six-year-old, and the semantic ability of pre-adolescents. In the same way, the left hemisphere has some ability to process spatial perceptions, a well-known right hemispheric function. For many hemispheric specializations, the opposite hemisphere seems to have about 20 to 30% of the same capacity.

Many authors and researchers have concluded that the sense of self is mostly woven out of language processes, which are primarily driven by

activity on the left side of the brain, where the main language centers are. This idea is found in many Eastern philosophies, which tell us that the self is a fiction that operates both when we're alone and we interact with other people, and even when we're dreaming, [and that silencing the inner monologue alters the sense of self]. Once we understand this, it's easy to see why groups of people who speak the same language hold the same expectancies and live within the same cultures and religions can be willing to fight or to die to maintain their "way of life". Many people can't imagine how they could live if their culture didn't exist, or if it underwent deep enough changes. The end of their culture, as they see it, is much the same as their own demise. Beyond this, it's the source of one of the most incapacitating anxieties, the fear of one's own personal death.

We're conditioned to suppress death anxiety. The three words "I will die" anticipate an inconceivable event, focused on the person who says or even thinks them, conjuring one of the most aversive events a human being can contemplate: their own death. Any process that can counteract this aversion and reduce the anxiety it creates will be so welcome that it can dominate a person's perception, the way they think about the world they live in, and their expectations about it. Comprehending the world around us and how it works is an essential part of human beliefs, [whether they're based on science, religion, myth, or delusions. Religion, with its nearly universal teaching that death is not the end of life, provides a way to remove the fear of death from a person's mind, and replace it with a more user-friendly way of thinking about it (such as "eternal life").]

Humans naturally take on beliefs that match their often misunderstood experiences. We process our experiences largely through the back half of the brain, and we interpret and process our expectations, what we find socially acceptable, as well as our ideas about what's ethically and morally sound, largely through the front of the brain. [No one is going to waste energy maintaining a belief that makes nothing happen, either good or bad.] If the consequences of our behaviors are disconnected from our experience, our beliefs will have access to the whole range of human behavior, and the effects of that can be quite damaging. [If you believe that someone from another race or culture is either inferior or evil, and there's nothing in your experience to teach you differently, then your behavior towards them is very likely to create animosity and destructive cycles of behavior. The frontal lobes with their

executive functions, provide the necessary controls to prevent self-destructive behaviors, even if your life experience includes episodes that strip your beliefs of complete certainty.]

Almost 30 years before the publication of this paper, we came up with the idea that if left hemispheric processes are the source of the sense of self as it appears in our daily lives, then there must be an equivalent “self” in the right hemisphere of the brain. However, its characteristics, features, and functions, as well as its subtle personality would be shaped by the functions of the right side of the brain. It would be more influenced by our emotions, spatial perceptions, and an absence of verbal meanings. [It would use images and pictures to think about things and events instead of words, much like the kind of ‘thoughts’ that come to us in our dreams, but act in a supportive role, as though there is a layer of dreaming behind our waking thoughts.] At the same time, the right hemispheric sense of self would be a semi-familiar portion of one’s own mind, but also different enough that we can’t really recognize it as ourselves in the rare moments when we perceive it directly.

When we first applied our signals, (derived from brain activity, and delivered through weak magnetic fields), with its field strengths (10%) greater over the right hemisphere than the left, the majority of normal volunteers reported a “sensed presence”. Many of the subjects in these experiments described it as a “sentient being” that was outside of their body [as distinct from being inside them, usually called *possession*], but was so significant to them personally, and relevant to their lives, that they very often had strong and even profound emotional responses to it. These experiments led us to believe that the “sensed presence” was actually an experience of the right hemispheric sense of self appearing to the left (day to day) “self,” (imposing its working information into it) so we can feel it directly.

The nature of the experience left the subjects unable to identify it as an aspect of their own minds, or as an effect of the magnetic signals. Instead, they believed it was coming from another entity in the room with them. We’ve suggested that the sensed presence might be the basis for the stories and beliefs found in every culture about muses, Gods, spirits and deities of the ancient world, as well as the experience of beings from ‘”other dimensions” and aliens we hear about today.

Because the most important source of differences within human beings is

gender and sexual dimorphism, even within the brain, we looked for differences in the experience of the sensed presence in men and women, both in how often they happen and in the details of the experience. We did a series of double-blind studies applying magnetic signals over one or both of the temporal lobes (above and in front of the ears) of 100 male and female volunteer subjects.

A significantly greater proportion of women reported sensed presence experiences than the men did. This was in agreement with the well-known greater similarities between left and right hemispheric brain activity in women than men. For both genders, the sensed presence was attributed to nonphysical beings, but women were more likely to also report sensations of movement or even dizziness, out-of-body experiences, apprehensiveness and the feeling that they were "in another place," in the same right-hemispheric session.

2.3 Vectorial Hemisphericity

If we agree that activity and excitement on the *left* side of the brain are experienced by the normal sense of self, and the self on the *right* is associated with the sensed presence, then we should see two broad ranges of experience and phenomena, dominated by the two sides of the brain. The first involving processes that belong to the right hemispheric *self* intruding into the awareness of the "self" on the left side, and the second involving the normal sense of self intruding into the awareness belonging to the right hemispheric sense of self (the opposite of the first). We arrived at the idea that the second of these would be experienced as OBEs and astral projection. [It's as though the self on one side of the brain is partly "emptied out," and sounds from the other one can echo into the space it previously filled.]

If one temporal lobe (for example) is very active, then the other will tend to become quiet. The same applies to the structures deep in the limbic system, as well as areas on the surface of the brain. Some brains have adjusted to, or even grown up with, a strong asymmetry between the same parts on the two sides. When dramatic events suddenly excite only one area on one side, those brain parts will work to bring themselves back to their normal levels, not into any kind of *absolute* "balance". Rather, it will adjust their activity back to *unbalanced*, habituated, levels of excitement. [To borrow a principle from chemistry: 'When a pair of brain parts are acted upon by an external event,

they first respond to the event, and then act to restore the state it was in before hand'. For some experiences, like falling in love, it can take months or years to complete the cycle. For others, like being startled, it can take just a few minutes. 21st century popular science, New Age thinking, and claims made for alternative healing methods often talk about "balancing the brain." In fact, a brain that's in balance in this sense would be just as prone to happiness as to fear, so an "unbalanced" brain is a very desirable thing, if the right parts are unbalanced, in the right arrangement.]

In order for the left hemisphere to accept information from the right in this way; for its processes to intrude into the left hemisphere, either the right hemisphere must be excited *above* its normal metabolic levels or the left hemisphere must be operating at *lower* levels than normal. In the same way, for left hemispheric processes to intrude into the right hemisphere, the left hemisphere has to be much busier than usual, or the right hemisphere must be a great deal quieter than it usually is. [Of course, as above, this only pertains to the parts of the brain that are involved in the experience (the phenomena), and may not involve the entire brain. If you see a flash of intense bright light, your eyes will have to adjust to come back to normal, but your ears won't have to. Processes like the ones we're talking about in this paper usually only affect the frontal and temporal lobes on the surface of the brain, and the limbic system, deeper down.]

One of the first things this idea or hypothesis ("*inter-hemispheric intrusions*") has to explain is why are so few moments in our lives given over to these experiences? One reason has to do with the normal mechanisms that *restrain* activity across the hemispheres, keeping their functions separate, but also integrated with each other. The two most important connections between the two sides of the brain for our purposes are the *anterior commissure*, and the *corpus callosum*. [For a long time, the first of these was thought to connect one limbic structure to another, as it does in other primates, but since the publication of this paper, it's been learned that most of its connections run from one temporal lobe to the other, with some limbic connections.] We can see how this works by looking at the number of neurons and connections between them. The average human brain has about 100 billion neurons in its cortex; the outer layer. The corpus callosum has about 200 million nerve fibers (axons). Only about .1% to 1% (depending on whose numbers you use) of the neurons on one side are directly connected to the other. [The two sides

of the brain, and the “personalities” they support, are 99 percent sequestered from each other. They are also so integrated that there are no such things as completely left or right sided functions, and the two “personalities” both contribute to the same person.] Even if we include the anterior commissure, a much smaller structure than the corpus callosum, the proportion of direct connections between the two sides of the brain are still no more than about 1%.

The interhemispheric intrusion concept implies that for either a sensed presence for an out-of-body experience to happen, activity or excitement in a specific part of the brain on just one side has to reach a specific “tipping point” [that will be different in different people, and also varies from one brain part to another]. The amount of energy involved needs to be enough to support the whole, *gestalt*, experience. [If there’s not enough energy involved, the sensed presence experience will fragment, and only individual components of it will be strong enough for the person to feel them. Several experiences and moods can happen along with (or be components of) the sensed presence experience. There might be a vague sense of meaningfulness, something numinous “in the air,” the sense that the ordinary concerns of day-to-day living are meaningless in this moment, the feeling that one has temporarily been “lifted above” the mundane, a sense of inspiration, perhaps to share an insight or realization, or perhaps an urge to write poetry. The nonphysical being; the “muse” might not appear, but the inspiration they bring can come through nevertheless.]

2.4 Populations Most Likely to Experience the Sensed Presence

Some forms of depression, in whole or in part, are symptoms of diminished activity in the left temporal lobe. In these cases, the right temporal lobe, functioning about normally, maintains its normal levels of activity and excitement. This difference between them means that the bar is lowered for the right temporal lobe to project its “self” onto the screen usually occupied by the one on the left [so that some people with depression are more prone to the sensed presence]. Frequently, brain injury patients who experience these presences often go through personality transformations, “converting” to whatever belief fits their experiences while in the company of the non-

physical being, especially if it's one of the more elaborate forms of the presence, like an angelic apparition. [They might become convinced that God has a plan for them, (if they interpret it as "his" presence). They might feel that the presence is a *spirit familiar* who is there to offer them guidance. If the experience is intense enough, they might feel their *spirit guide's* presence constantly, and turn to it often.] After such an intrusion, the levels of activity in the left temporal lobe may be raised or even restored, but they will have acquired a "temporal lobe personality," similar to what we see in people with temporal lobe epilepsy. The heavy turbulence in the frontal lobes during any event that alters neural or metabolic activity in the temporal lobes will also contribute to personality changes.

Besides feeling that one "has become a new person," someone like this may come to believe that they have been "chosen" and directed by some "higher power" that exists outside them. They often find that their thoughts keep returning to their experiences long after they're over. Its implications, at least within their own mind, can be so profound that they feel compelled to try to write it all down, in journals or diaries, or to write their own scriptures, revelations, or explanations of the spiritual basis of the world that surrounds them. [In this editor's experience, it often takes the form of a fascination with quantum mechanics, consciousness, and DNA. Decades ago, there was a common fascination was with the physics of vibrations ("wave mechanics"), special relativity, and the laws of thermodynamics (trying to understand spiritual or subtle *energy*).] We can also expect that the person will feel that events, whether normal or unexpected, are infused with personal and emotional importance, and/or can have cosmic implications or meaning for the whole of humanity.

Another situation that can promote these experiences is life-threatening danger [especially when accompanied by intense arousal states, as the person works at their peak performance level to escape the threat]. Sudden changes in the amount of blood flow to the occipital cortex (at the back of the head, where they primarily work to process vision) can induce a tunnel-like visual experience. Feelings of movement, meaningfulness, visualization of memories, darkness and light also reflect the vascular [and other] changes in the structures that support these experiences. [In one example, the hippocampus on the right side is instrumental in the perception of both space, and movement through it. So, movement through a tunnel or a "void,' as in

near-death experiences, become a natural reflection of unusually high activity or excitement there.]

Another group of people who are more prone to these experiences are creative writers who stay up to the early morning, working on their compositions. Normally, they would be asleep at this time of night, and the activity in the right side of their brain would be dedicated to sleep and dreaming. However, because they force themselves to stay awake, they inhibit this right hemispheric activity, and it can cross the brain for a few seconds, and inform the left hemisphere, creating a sensed presence experience. Because the left hemisphere contains the language centers, this process occasionally recruits them, and the person might hear an "inner voice," that feeds them the words they're writing, as though it were a muse. They might also hear a voice calling their name, through much the same process.

The people with the richest groups of experiences are those who have electrical or structural anomalies ("loci" or even "glitches") inside one of their temporal lobes, especially among patients with temporal lobe epilepsy. This creates a difference in the way the functions of the temporal lobes are organized, with some brain jobs now being routed along different tracks than they normally would. This encourages the sensed presence experience and also out-of-body experiences, as well as "journeys into other dimensions," when these compromised areas become unstable. In some cases, these can last for a long time (like *status epilepticus*), and bring the person into extremely powerful emotions, like terror or rapture. When this happens, disinhibition of the brain's cognitive ("thinking") regions can remove the limits from their ability to think. They might have profound realizations or feel that they're receiving new information that they intuit is coming from another dimension or a higher power, and these can go past the limits of their education, cultural learning, and even their personal level of intelligence.

Yet another group of people who are predisposed to sensed presence experiences are the victims of closed-head injuries. Sometimes, at least outwardly, they look like minor injuries, but they can have a profound impact on a person's subjective experiences. In most cases, they don't even involve a loss of consciousness. We published a paper in 1994, which told how they found that the majority of these patients experienced the sensed presence. More than 95% of the ones who reported it also said they felt like they were

no longer the same people they were before their accident. Their neural profiles were very similar to those of people with temporal lobe epilepsy.

When the sensation of the sensed presence appears on the left side, it's usually unpleasant and fearful. If it happens along the right side, the emotion is more positive and the person is more likely to hear messages or their name spoken within their mind. Interestingly, most people in this group hear a voice of the opposite gender. Although most experiences last about 10 seconds, routine EEGs taken from hundreds of normal clinical tests eventually find a few people who have these experiences right during an EEG procedure, where they can be seen clinically, and this made it possible for us to find supporting EEG data.

One patient's electric shocks, icy coldness, vibrations running through their whole body, and the sensed presence were associated with low-frequency irregular (*paroxysmal*) activity from the temporal lobes. In another case, similar activity was recorded for about 10 seconds from the right temporal lobe after the subject (an experienced female transcendental meditation teacher) had done their normal meditation practice for about 15 minutes. She said she felt an "infinite presence," which she called God, with her in the laboratory.

In the late 1800s, Hughlings Jackson, a pioneering epileptologist, wrote about the sensed presence, calling it a "parasitic" or "second consciousness," that temporal lobe epileptics often reported. He even explained them as electrical anomalies in the right temporal lobe, about a century before this paper was written. Much later on, other researchers found a long list of behaviors that match up with this kind of electrical stimulation, coming from inside the brain itself, when it's focused on the area where the temporal lobes meet the parietal lobes. They also found historical examples [including several famous saints] where a holy person's subjective experiences and behaviors *both* reflected this kind of neural activity. They also found that they tended to repeat the themes of the two classes of mystical experiences ["the way of meditation and the way of prayer"]. These moments of instability tend to repeat, especially for actual temporal lobe epileptics. As they do so, they sometimes recruit new groups of pathways into the event, and the details of the person's subjective experiences, beliefs and behaviors can be changed in the process. In fact, temporal lobe epileptics are much more likely to experience religious conversions than others, and they often do it several

times.

Another researcher catalogued groups of behaviors that happen more and more often as temporal lobe epilepsy progresses, as the temporal lobes keep stimulating themselves. Watching these changes over years, he arrived at the conclusion that the slowly increasing extra connections, especially between the cortex and the limbic system, resulted in the patient's giving more and more emotional significance to their own perceptions and thoughts. This 'between-seizure' behavior shows an impressive variety, because each person's thoughts and perceptions are personal and unique.

These changes, with the irregular and bumpy effect they can have on normal brain function, can have a significant impact on our cultures and societies. It's now thought that Socrates' apparent extra measure of intelligence may have been associated with altered state experiences in which he spoke with an "invisible" being, which he called his *daemon*. [His willingness to engage altered states is testified by an anecdote from the Greek historian Xenophon, who reported a story where Socrates watched the sun rise, and stared directly at it until it went down again.] Many religious conversions and awakenings through history, involving religious leaders both famous and forgotten, have been the source for the beliefs of billions of people, and this may be the primary social consequence of these experiences.

3.0 Experimental Production of Mystic Experiences

3.1 **Invasive Electrical Stimulation**

In the late 19th century, two German researchers electrically stimulated the exposed brain of a cadaver and recorded movements from the body in response. Ever since then, researchers have realized that brains can be affected by outside electrical events. In the mid-20th century, developments in brain surgery allowed surgeons and neuroscientists to stimulate the surface of the brain with electrodes. This work demonstrated that all the components of mystical states and experiences could be elicited by the appropriate stimulation of the temporal lobes, especially on the right side. These included both the feeling of a presence nearby and the sensation of "being somewhere else." These sensations implicate the middle and lower portions of the temporal lobes, most importantly the amygdala [an emotional and social structure], and the hippocampus (a "cognitive," or "thinking" structure].

Clinical experiments by Vernon H. Mark, in the late 1960s, also provided examples. They used electrodes (pen-like devices that produced low-power electrical currents at their points) to stimulate the amygdala. This produced elaborate, confused mental states that included “nirvana-like” pleasant emotions, and the experience of seeing themselves from the outside (“diplopia”), similar to OBEs, déjà vu, and fear. While this was going on, they also monitored the patient’s brains with EEG, and found that the neural activity during these experiences was mostly in the theta band (4 to 7 Hz). This kind of experiment also found that the hallucinatory images created this way were partly determined by what was in the patient’s minds just before they applied the stimulation.

In 1994, another researcher found that the “dreamy states” (as these experiences were once called), seen from brain stimulation decades earlier, appeared for about 10% of the epileptic patients when their temporal lobes were stimulated in this way. Another researcher realized that these experiences appeared because the stimulation had spread to the hippocampus and the amygdala. In addition to some visceral sensations, which the researchers knew to expect, they also noticed that patients reported déjà vu, and that their memories were woven into their perception of the present. There were also reports in the late 1980s of OBEs and sensed presences evoked by stimulation of the right amygdala.

“Knots” in the temporal lobes, especially the ones that work to produce epileptic seizures (“loci”), showed the greatest match with these kinds of experiences. Another pair of researchers, working in the late 80s, measured these areas with magnetic imaging, and found regions of dense magnetic lines of force in the temporal lobes, with vibrations in the theta and delta ranges (2 to 7 Hz), the kind of brain activity that’s been associated with deep meditation states, trance, and twilight sleep. Normal people did not display these magnetic “knots.” Other brain stimulation methods could also activate these spots (“foci”), including chemical stimuli, unusual environments, geomagnetic activity, or magnetic fields with signals matching the ones being read from the magnetic imaging device (magnetoencephalopathy or MEG).

In 2004, Olaf Blanke and his colleagues were able to elicit out-of-body experiences the sense of a presence, and changes in how large objects around the patients looked (“macropsia”). They accomplished this by stimulating the area where the temporal and parietal lobes meet with an electrode.

Other researchers, using electrical stimulation in about the same place, found that it triggered a strong desire to move the opposite side of the body. So, in this case, stimulating the right parietal lobe made the patient want to move the left side of their body, and vice versa. When the stimulation was increased, the patients believed they had actually moved, even though they were keeping still. What they experienced simply had not happened. Stimulation of areas that help us make body movements ("premotor" areas) produced obvious mouth movements, and movement of the limbs on the opposite side, which the patients denied. Wilder Penfield's stimulation of the temporal lobes in the 1950s also produced mouth movements, especially lip smacking.

Many patients who sustained injuries in this area (where the parietal lobes meet the temporal lobes) on the right side also neglected the left side of their body. [For example, they couldn't recognize their own left hand, and when they were confronted with it, insisted that it wasn't theirs. There are also a few reports of people experiencing a "second self" or another "identical person." They were so convinced that they actually searched for the person, and were unwilling to believe that they didn't exist. There have been other cases where patients with internal damage to the right temporal lobes have had experiences of seeing a "small humanoid" or an ethereal human form.

One researcher showed that when a loss of spatial awareness happens because of problems in the right parietal lobe, the disturbance also interfered with activity in part of the nearby right temporal lobe. This showed how strongly interconnected these areas are. [One of the principles of epileptology is that] when an area of the brain doesn't work properly (the "umbra"), or doesn't work at all, the areas around it (the "penumbra") are often disinhibited, and become more excitable than usual. For clinicians, this means that when they see an area of the brain with increased metabolism, they should also be on the lookout for nearby areas (or the same area on the opposite side of the brain) that are working more slowly than they should. [When this happens in specific areas of the limbic system, the threshold for specific experiences will be lowered, and the person can find themselves with unusual skills or subject to strange experiences. Usually, these experiences are unpleasant, but in a few cases, they can confer exceptional spiritual skills or an aptitude for entering mystic states of consciousness.]

3.2 Whole Brain Correlates of Mystic States

Although direct stimulation of the brain with electrodes, either implanted, or the older handheld variety, allows brain surgeons to find and remove damaged areas, it's an invasive procedure. The subjects are usually epileptic patients who didn't respond to antiepileptic medications. The electrical currents have to be strong enough to produce their effects quickly. The stimulation is usually followed by "afterdischarges," and while these are tapering off, there's a phase where the strength of the afterdischarges matches the strength of the brain's own normal electrical activity. In these moments the two can interact and exchange information. This phase may be equally important, especially for the type of investigation we're doing here.

We've also learned a lot from the gentler ("noninvasive") ways of studying the brain, which don't involve opening the skull, or boring holes in it, like fMRI, EEG, and SPECT. In one case, a sensed presence, which appeared during the very first phase of an epileptic seizure (called an "aura"), was shown to be connected with a decrease of blood flow in both temporal lobes. In that instance, it seemed to have religious overtones. In other work, the sensed presence, when it occurs during prayer, quiet thinking, or meditation, was found to be connected with increased metabolism in the parietal area on the right side.

It also helped when researchers asked their subjects to engage in specific tasks while their brains were being monitored. In one example, two researchers asked people with a lifelong history of religious beliefs to remember their experiences with God. These subjects showed more activation in the brain areas involved with memory. This included the right frontal lobe. Another researcher showed that subjects who were reciting religious texts responded with more activity in the pathways that connect the frontal and parietal lobes.

In 2008, another pair of researchers reported that the temporal lobes are involved with religious experiences, while changes in frontal lobe functions contributed to interest in religion (as a personality trait) and how likely they were to choose a religious vocation. It showed that different areas of the brain are involved in religious experiences and the person's own religious thoughts about them. [This may explain why some people who have no history of mystic experiences can still be drawn to a priestly life, and may focus on

morality and points of belief instead of mysticism but may find themselves unable to understand people who have epiphanies, feel God's presence or become deeply absorbed in prayer.]

The frontal lobes of the brain are also involved with our moral judgments and the way we treat other people. They also found that moral judgments were modified when experimenters made changes to the way they operate. When very high-powered magnetic stimulation was applied to the right side, where the temporal lobes and the parietal lobes meet, the effects of beliefs and moral judgments went down. This area is richly connected to the frontal lobes, so these effects aren't surprising. [They should also remind us that religious belief and spiritual experiences may be separate phenomena, but they're also deeply connected.]

This finding suggests that increases in the activity in this region will make religious belief stronger, if they come from spiritual experiences that strengthen moral judgments. The strong cooperation between these areas and the behaviors we see in schizophrenia when these two somewhat distant areas operate abnormally can also explain the very strong overlap between schizophrenia and religious or mystic states. [We shouldn't forget that, although spiritual states are within the normal range of the human mind, they can also appear in psychiatric disorders. In fact, there are skeptics who try to explain all religious beliefs and experiences as little more than delusions, while we see them as facilitating adaptive behavior between individuals, in spite of their often destructive impact on society and politics.]

3.3 Noninvasive Experimental Production of Mystical Experiences in Normal People

We've been using magnetic fields with complex signals (with field strengths that change every few milliseconds) in order to influence the processes associated with states of consciousness and mystic experiences. The *average* field strength is about 50 Milligauss (50 mG). This is 1 million times less than the strengths of the magnetic fields used in one clinical magnetic stimulation procedure, rTMS. Nevertheless, these magnetic fields produce very significant changes in cognitive and emotional states, and are easy to see in EEG data.

4. Externally Applied, Week, Physiologically Patterned Magnetic

Fields

4.1 The Field-Field Interaction

Our magnetic stimulation does not work through current induction, where a strong magnetic field can directly elicit an electrical current. Rather, the process is closer to the interaction between solar wind and the Earth's magnetic field. [We can also offer a metaphor where the Earth's magnetic field interacts with the very lightweight magnet used in an ordinary compass, and induces it to move, so that it points north. The compass needle doesn't need to respond with electricity in order to "know" where north is. If you were to place a compass needle near a magnet that's wiggling back and forth, the compass needle will also wiggle, and the speed of its back-and-forth movements will show the frequency of the magnetic signal generated by the wiggling magnet. Once per second will be 1 hertz, and a hundred times per second will be 100 hertz. If our magnet moves *irregularly*, then we'd call the pattern in the compass needle's movement a *complex signal*. Maxwell's equations tell us that changing magnetic fields will make changes in nearby electrical flows, including along axons.]

There appears to be a tipping point where were the electromagnetic activity in brain cells can interact with the magnetic fields we apply from outside the head, and this threshold is about 10% higher on the right side of the brain. When we apply our signals with 10% greater strength over the right side, we find that the strength of theta activity in the left temporal lobe soon matches that of the right prefrontal lobe. If we then stimulate both sides of the brain at once, we find these waves on the left side adjusting themselves to match those on the right (or we could also say that there is more right-to-left coherence). These two kinds of stimulation (right side only *or* right side using one signal followed by another signal over both sides, have both been seen to elicit the sensed presence, and both have elicited OBEs.

4.2 Connection between Consciousness and EM Fields.

One of our assumptions has been that states of consciousness including mystical states can be thought of as quanta of brain states. Here, states of consciousness are *analogous* to quantum states, not expressions of sub-atomic processes. If consciousness and thought rely on movements of electrons in the brain, then it should appear on a much larger scale for the

whole brain, and we should expect to find the entire brain's magnetic field strengths match the strengths of the brain's overall electrical activity.

4.3 [This is a mathematical treatment of secondary magnetic fields, including orientation with respect to the earth's magnetic field.]

4.4 Method of Application

Thirty years of our research applying our magnetic signals to cell cultures, rats, mice, and human beings have made it clear that simple frequencies (like sine waves) in magnetic fields have the *least* effects on human states of consciousness. Although a great deal of brain activity can be *described* in terms of frequencies (such as delta, theta and gamma "brain waves"), affecting it with magnetic signals that interact with the brain's electrical activity means using much more complex patterns. The simple math involved in seeing the brain's activity as a collection of frequency bands is helpful when interpreting an EEG, but it breaks down when we try to use simple frequencies to alter the complex brain activities.

Our applied magnetic signals are effective because of their non-uniform, irregular, shapes. To interact with the brain's own electrical and magnetic activity, our magnetic signals conform to the specific irregular shapes the brain produces (visible on EEG) in specific circumstances. To use an analogy, the signal is like a key, and the corresponding electrical activity is like a lock. If they're not coherent, or they don't fit, nothing will happen. [If we use signals that the brain uses *constantly* in its normal functioning, it will habituate to them very quickly, so we use signals that only appear occasionally; in specific circumstances, and derive from specific structures. Moreover, the information content is more important than the strength of the field that carries it.]

We can offer a couple of metaphors. First, a sentence can be screamed or whispered. Screaming takes a *lot* more energy than whispering. However, the meaning of the sentence is the same in each case. In another metaphor, a complex chemical shape, like LSD, has to fit into specific receptors in the brain. A chemical with a mirror image of LSD's chemical shape won't have the same effect. Very small differences in language can change the meaning of the sentence, and very small differences in the shape of an LSD molecule can change or even keep it from influencing the brain. Similarly, small

changes in our magnetic signals can prevent them from having any effect.

If we think of consciousness as a field, and look at its smaller and smaller components, we'll eventually find it composed of minimal discreet units ("quanta" of consciousness), with some kind of structure or organization. The specific ways these neural quanta [here, we're using quantum mechanics as a metaphor] interact with each other would contain and manage the information within it. Applying a uniform, homogenous magnetic field, without complex signals, would not necessarily change the ways these neural quanta interact with each other [we can think of them as quanta of information, not mass or energy, as in quantum mechanics]. To put it simply, complexity increases the effects of magnetic signals. Further, the complexity of the *locations* for the magnetic coils also contributes. As expected, we found that 64 magnetic coils distributed evenly over the head produces more intense altered states of consciousness and mystical states than the God Helmet's standard eight coils. [With respect to temporal lobe stimulation, we've also found that rotating the fields in a circle around the periphery of the temporal lobes produces more robust altered states and mystical experiences than static, nonmoving, fields.]

Over the last 30 years we've consistently found that for rat and human studies, the greater the contrast between the different components of the signal (the more irregular they are), the greater the resulting effects, even with lower field strengths. Every type of stimulation has a threshold, determined by how sensitive the person (or kind of laboratory rat) may be. If the magnetic field carrier for the signal is too weak to influence the system at all, the signal will have no effect, and the same is true if the magnetic field is too strong.

4.5 Contemporary Application Geometries

We designed the "Koren Helmet" (the "God Helmet") with the maximum amount of variation, both in the signal and the configuration of the magnetic coils to deliver them. The helmet uses four coils (using adapted reed relay switches) on each side, and when it's being used to stimulate both sides of the brain, two coils, one on each side, are active at once, "yoked" to each other. The God Helmet has a switch that allows the coils on one side to be shut off. In the laboratory, the signals are "sequenced" so that only one coil (or pair of coils) is active at a time. In most cases, one cycle takes two seconds. An alternative design exists (in our lab), in which two containers hold the coils,

and these are strapped over each temporal lobe. This design allows us to apply our magnetic signals over more regions of the brain. Further, we can modify the field strength to a range of 10% to 50% of our standard field strengths.

Professor Todd Murphy has designed faithful PC-based versions of these technologies using ordinary magnetic coils. When a small electric current with our signals is run through them, they generate complex magnetic signals that can be applied over specific areas of the brain. The magnetic coils are driven by audio files produced on a PC computer. As a result, the very complex magnetic signals we use, which might be considered the language of the brain, became available to the public.

4.6 The Importance of the Point Duration

Our signals are generated by computer files. Each file consists of a column of numbers (0 to 255 – the DOS operating System limit), and each number corresponds to a voltage that's fed to the magnetic coils, converting electricity to magnetic fields. The voltages range between -5 and +5 volts with our solenoids. Each number constitutes one pixel, and the length of time for the pixels is entered into the software that controls the (laboratory) stimulation system. The signals can be displayed on a graph, with one axis for time, and the other for voltage.

After experimenting with different durations for our pixels, we found that 3 ms is the most effective for our experiments both with mystical states in people, and analgesia in rats. Signals with longer or shorter pixel times are less effective and some have no effect at all. We experimented with pixel durations between one and ten milliseconds. Our first apparatus used an IBM 286 computer, and later computers achieved the optimum pixel durations through a special calibration utility. Any failure to control the exact durations of the pixels may result in no significant effects appearing. For example, a group of Swedish researchers who didn't maintain the correct value were unable to discern any differences between subjects and controls. The actual scores for both of their groups were almost identical to our control groups, suggesting that the optimal field parameters were not applied. In addition, the Swedish research group ran the signals under Windows. When this happens, Windows' control of the computer port (the LPT port, where the output device was attached to the computer), adds a distortion. This has no effect on

its ability to print a document, (it's a printer port), but it distorts the signals, similar to the way a broken audio cassette can change the speed of the music it's playing, adding a "warble". Not only are the pixel durations lost, but so is the shape of the signals. [We continue to use our older DOS-based computers to this day, as well as Professor Murphy's signals, which are produced using audio devices, and don't have this kind of distortion.]

We're not the only research group that's found biological effects of magnetic fields with 3 ms pixels. It's also been found to help stimulate molecular pathways and help bring calcium into cells, an effect that one can watch in real time. A couple of researchers have shown that magnetic fields with point durations of 3 ms diminished cell growth in certain kinds of cancer. The same effect did not occur with normal cells. In these cases, the magnetic signals had to be applied for at least 30 minutes to have a significant effect, although minor results begin to appear after about 15 minutes.

The effects of our magnetic signal neural stimulation usually peak at about 30 minutes, with their first subjective effects usually appearing about 15 minutes after the stimulation begins. When the field is turned off, the subject usually returns to their baseline in about five minutes. [However, pleasant effects, both intermittent and constant, have been reported in the hours and even days after the session.]

The lead time for the effects to begin gives us further reason to believe that that these complex magnetic signals work by transferring information from one field to another, and not through current induction. To put it another way, our stimulation *invites* the brain to respond, while high-powered magnetic stimulation such as rTMS (Repetitive Transcranial Magnetic Stimulation) *force* the brain to become more active. If our complex magnetic signals worked through current induction, the effects would appear immediately. We found that it required approximately 15 minutes of stimulation before it induced a marked altered state. It took about as long for cell cultures and rats receiving full body stimulation to manifest measurable effects. The implication is that there are thresholds in time as well as in field strength.

4.7 The Pattern of the Fields

A sine wave is a symmetrical signal, and these have been the *least* effective for producing mystical states, unless they're made to change constantly through phase modulation. Irregularly shaped signals, one with a burst firing pattern, and another that uses frequency modulation (a "chirp" signal) have been most effective for us. Both of them are asymmetric, and both have constantly changing frequencies, so that it's not possible to say what frequencies are used (a common question).

The irregular shape of the signal is as important for our work as the shape of a molecule is for its chemical effects. As we tested the signals and their variations for producing mystical experiences, especially the sensed presence, we found that we only had to reverse the signal (play it backwards), to eliminate the effect. We also noticed a similar result when we stimulated cells being cultured in petri dishes. When we broke up the signal, and presented only parts of it, it had no effect on the slowing growth rate of the cells, whereas the growth rate was significantly higher when we presented the entire signal.

4.8 Why Frequency Modulated Versus Fixed Frequency Fields?

Symmetrical, fixed frequencies (like 60 Hz sine waves) don't change their frequencies, or they'd be a different kind of wave. On the other hand, changing the frequencies allows information to be transmitted and received (even without any regular rhythm). [Think of the sound of Morse code. Its dots and dashes appear, reflecting the letters and words it's transmitting. When you listen to it, you hear constantly changing frequencies (in time, not pitch), without any pattern at all. If you understand Morse code, then the 'patterns' in it will mean a lot.]

Further, there's the problem of *habituation*. In general, the brain has a harder time habituating ("tuning out") more complex signals, and the greater the difference between its component frequencies and amplitudes, the longer it will take. In contrast, a simple 60 Hz magnetic signal would be able to hold the brains attention, so to speak, for about 20 milliseconds. Interestingly, this is less time than the brain experiences as "the present."

The effects of our irregular signals build up over about 15 minutes, until their effects reach that specific person's individualized threshold. In the God Helmet, their effects are augmented by cycling the signals through four pairs

of magnetic coils, and each time the signal appears through one of them, a different ‘slice’ of the whole signal than the previous ‘slice’ was fed to that coil. To put it another way, the length of the signal can’t be divided by the length of the rotation cycle, so a different part of the signal appears from each magnetic coil each time. This adds a further irregularity to the stimulation, making it even more difficult for the brain to tune it out.

4.9 Comparison to TMS

TMS, *Transcranial Magnetic Stimulation*, is an effective method of neural stimulation that uses magnetic fields approximately one million times stronger than the magnetic fields we use to deliver our signals. However, both have proven to be about equally effective when used clinically, especially for patients who became depressed, mildly or severely, after sustaining a closed head injury.

One of the reasons is that TMS uses fields strong enough to affect every cell in the brain, while our fields are strong enough to affect only the cell membranes, which are “triggered” by much more subtle magnetic fields. Nevertheless, they apply enough energy to affect about 10 billion out of the brain’s 100 billion neurons [about ten percent]. In contrast, TMS stimulation involves enough energy to affect not only the brain’s electrical activity, but its entire metabolism, including its blood flow, and the mechanisms that our bodies working right (the *autonomic* system).

4.10 Convergence with and Accommodation Blanke’s OBE Results

Another researcher, Dr. Olaf Blanke, stimulated the exposed brain of an epileptic woman using an electrode pen, and elicited an out-of-body experience. He stimulated the *angular gyrus* on the right side, about where a deer has its horns. Our research suggests that increased activity in the left temporal and right prefrontal lobes is associated with out-of-body experiences. The similarities in our results appeared in spite of the fact that our different methods rely on different brain mechanisms. [It’s worth noting that the Canadian neurosurgeon Wilder Penfield obtained results almost identical to Dr. Blanke’s in the 1950s, using an electric probe.]

As above, our procedures work over a longer time, 15 to 30 minutes,

while an electrode pen elicits its effects almost immediately. [It's also worth considering that *withdrawing* the electrode from the surface of the brain in this area could have created unique electrical activity, perturbing the normal functions of the angular gyrus, and the out-of-body experiences occurred as the angular gyrus turbulently restored itself to normal functioning. Our approach takes longer, but uses non-intrusive methods.]

Both of our laboratories have investigated similar events, induced through two very different mechanisms, which we explain in terms of unusual activation of the normal functions of that area (spatial perception, including our sense of our location in space ("proprioception")). Blanke's (50 Hz, two second) stimulations of the right temporal parietal area would have been enough to disturb brain areas that ordinarily suppress function there, [as well as reflecting the functions in the area being stimulated. For the angular gyrus, this includes our perception of our location in space. This disinhibition would elicit an OBE, but the same "opening" (disinhibition) could also create the macropsia (seeing things as larger and farther away than they actually are) that both Blanke and Penfield reported].

4.11 The Importance of the Context and Reduction of Sensory Input

From the very first studies in the 1980s, we've seen that reports of the sensed presence and out-of-body experiences have depended on the environment for the sessions. Throughout history, religions and mystic traditions have been founded on revelations coming from the spiritual visions of mystics. Many of these received their visions in partial sensory deprivation, like caves, deserts, or other isolated places. In most cultures, spiritual practices that promote introspection are seen as ways to make contract with "the higher powers."

In our laboratory experiments, subjects sit in an absolutely quiet, completely darkened and vibration proof room. Most home users of Todd Murphy's Shakti and Shiva systems are unable to create such an environment. Nevertheless, it also creates significant mystic states and experiences, including feelings of detachment. This rigorous sensory deprivation means that the millions of neurons that respond to vision and sound, whether passively or actively, are unoccupied, making them available to respond to the magnetic signal stimulation. Maintaining a blank and dark

visual field and eliminating *all* noise allows us to use lower field strengths than otherwise. At first, some initial experiments used quiet relaxing music, but it turned out that this actually reduced the number of sensed presence experiences [though other significant experiences did occur, including one by a journalist who experienced himself as being transported back in time to an ancient Tibetan temple in a fairly prolonged visionary episode].

In one fascinating effect, we found that keeping a dim red light on in the sensory deprivation chamber, the kind used in film developing labs, increased the incidences of sensed presence, when the appropriate magnetic signals were used. This effect is a little peculiar, because the subjects wore a blindfold, and couldn't actually *see* the light.

Although the *type* of experiences generated by the God helmet depend on the specific signals used in each session, the labels and names that people used to describe their experiences largely depended on what they expected from altered state experiences in other contexts. The words they used to describe their God Helmet sessions, including their connotations, reflected their experiences as they remembered them once the session was over. The experiences can be quite ephemeral, as we saw in our "button pressing" studies where the subjects were told to press a button when they sensed the presence. The subjects that put labels on the experience (which could range from a "spirit" to his or her "own brain") were a lot less likely to recall the experience. [To clarify, there were many instances where the subject pressed the button, indicating that they felt a presence in the room, but didn't remember the episode when the session was done. Something similar happens in the way people remember or forget their dreams.]

Because of the effect of expectation on the *content* of the experience, in contrast to whether or not the subjects *had* an experience, we've taken great care to ensure that the subjects had neutral expectations. The volunteer subjects were told they were participating in "relaxation studies". The lab technicians who conducted the experiments didn't know what hypothesis was being tested, or what kinds of effects we expected from specific magnetic signals.

[One of our other observations has been that the ideal time of day or God helmet sessions is from midnight to 4 AM, when melatonin levels are reaching their peak. This is accompanied by decreased stability in the brain,

allowing the signals to recruit more activity from whatever structure the specific signal targets, and from there, any pathways it's connected to.]

5. General Patterns of Subjective Experiences and Quantitative Electroencephalogram for Correspondence

5.1 Subjective Profiles and General Statistical Correlations

In the year 2006, we reviewed and reanalyzed approximately 20 experiments, with 407 subjects who had experienced either the sensed presence or out-of-body experiences during their God Helmet sessions. This reanalysis showed us clearly that the specific signal being applied, and neither their spiritual or religious beliefs, nor their suggestibility was responsible for the incidence of sensed presence episodes. [For example, a signal that appears when the brain is creating long-term memories out of present experiences turned out to elicit fewer presences, and it was also more pleasant when we applied it over the right side than they left, contrary to our initial expectations for that signal. If our results were due to suggestibility, then the "pleasantness" would have been the same in all cases.] The subject's previous history of spontaneous sensed presence experiences showed a moderate match with their private religious or spiritual beliefs, as well as the sensitivity of their temporal lobes. The location of the magnetic coils determined whether they felt the presence on the left or the right. Their beliefs did affect the details of the experience, but not the side of their body the presence appeared on, or whether the presence felt positive or threatening.

The experiences were rich in details, similar to what is been reported from invasive direct electrical stimulation (as with electrode pens). In one example, a 21-year-old woman with a history of diabetes reported "I felt a presence behind me and then along the left side. When I try to focus on its position, the presence moved. Every time I tried to sense where it was, it moved around. When it moved to the right side, I experienced a deep sense of security like I have not experienced before. I started to cry when I felt it slowly fade away (we had changed the magnetic signal). (This case also appears elsewhere in this book.)

A 25-year-old man with a history of three "mild" head injuries, who had completed his bachelor's degree, reported an OBE while exposed to one of our magnetic signals. He reported, "I felt as if there was a bright white light

in front of me. I saw a black spot that became a funnel; … no tunnel that I felt drawn into I felt (I was) moving, like spinning forward through it. I began to feel the presence of people, but I could not see them. They were along my sides. They were colorless and grey-looking. I know I was in the chamber but they were very real. I suddenly felt intense fear and felt ice cold." [It's worth noting that the sensation of spinning and moving through a tunnel also appears in many reports of near-death experiences. Note: Persinger included this report in several of his papers]

5.2 QEEG and sLORETA patterns

In 2009 we introduced quantitative EEG ("Queeg")and sLORETA (low resolution electromagnetic tomography) into our laboratories and we were able to view and compare the patterns of subjective descriptions of sensed presences, out-of-body experiences, and whole brain activity, as well as see how these matched with the vectorial hemisphericity hypothesis. For subjects who reported out-of-body experiences, there was a substantial match between the left temporal lobe and the right frontal lobe. From these studies, we can say that the normal sense of self, primarily driven by processes on the left side of the brain, recruits information at work in the right frontal lobe during OBEs. In contrast, those who experienced the sensed presence showed a significant match between the left and right temporal lobes, in the *beta* range, which we didn't see in subjects who felt the presence rarely or not at all [about 1/3rd of the population.]

We also had the idea that the sensed presence may be an "avatar" of the information at work in the right side of the brain while the experience is happening. The presence's specific manifestations, such as whether or not the person sees it, hears it, feels as though it has touched them, or whether they only sensed it's presence around them, depends on which areas of the brain are recruited into the experience the magnetic signals provoked. The patterns we've found to be most effective also seem to appear in the world around us, and can be generated by geomagnetic activity and/or the electronic technology that has filled our world for decades.

One obvious discovery, which came as no surprise, is that many conditions can produce these experiences. Our magnetic signals, when applied correctly, are only one kind of them. We've worked with the idea that (being reflections of some of the brain's own signals) there is a kind of

“ideal” signal [or perhaps “archetypal” signals], and that both the brain’s own activity and our signals must resemble them to some degree in order to create these experiences.

[This implies that there’s a *signature* for the sensed presence, and it follows any stimulus that either triggers it or makes it more likely. It might come from a small-scale seizure, the earth’s magnetic field, or our signals]. If the signal (or one like it) isn’t there, the presence becomes very unlikely. A signal has to match one of the brain’s own signals for it to have similar effects, but we don’t know just how closely. Remember that the less the parts of a signal repeat itself, the more the brain responds to it. The signals in the earth’s magnetic field are turbulent compared to our magnetic fields, and probably never repeat themselves at all, so our brains are less likely to tune them out, even if we’re not aware of them, and some people, will never be aware of any of them. They may not need to match any of the brain’s own signals to have subtle effects, them and can “prime” it for the presence to appear (in those who are sensitive to it). We don’t have any way of ‘reading’ any information encoded in a magnetic field’s fine-grained structure. Some people are much more sensitive than others, and for them, it may only need a subtle stimulus to trigger the experience, while others need a more robust one. The signal that triggers the presence could be faint or clear. It might come by itself, or as part of some electromagnetic noise. It might be present in the geomagnetic field from time to time. It might occur as a ‘complex’ harmonic, so our scale of magnetic intensity might hinder instead of helping the search for ideal signals in our brains and in the earth’s magnetic field. For example, one of our signals is a burst-firing pattern originally taken from the amygdala, a very sensitive limbic structure with emotional and social functions. In the brain, the signal will never appear exactly the same way twice, so the neuron’s electrical connections may be affected by signals that are only *similar* to the one that contributes to the *presence*. [Our signals, as we use them in the lab, are able to achieve (and may even require) greater precision.]

[Another possibility may be that the sequence of signals in our sensed presence protocol is a decisive factor. Activating the amygdala (using the amygdala burst-firing signal) in both hemispheres is more effective when it follows a ‘chirp’ signal applied over the right temporal lobe. It may be that the God Helmet mimics some of the natural triggers for mystic experience

that we can encounter in our ordinary lives (like childbirth, narrow escapes from danger, falling in love, exhaustion, or the death of a loved one, to name only five.)]

Another of our discoveries has been that the way the brain is naturally organized, in combination with other factors, like early brain traumas, and the person's overall sensitivity to altered states, has a strong influence on the type of experience they have in response to the God helmet. These factors also influence the way the brain temporarily reorganizes itself in response to the stimulation. Because the brain changes its state several times per second, and because we frequently use more than one signal in our God helmet sessions in the laboratory, some people report both OBEs and sensed presence experiences in the same session.

In some states, our magnetic signals may be enough to create entrainment strong enough for us to measure it on EEG it. One of our experiments showed that one of our signals (the burst-firing pattern), a short signal that repeated once every four seconds, was enough to entrain brain activity during one kind of dreamless sleep. The same signal has been associated with analgesic effects in both rats and humans. In rats, 30 minute exposures to this magnetic signal produced an effect equivalent to about 4 mg of morphine per kilo of body weight.

6.0 Conclusions

Applying the scientific method has allowed us to develop a technology that reveals the neurological basis of mystical and altered state experiences, which have been explained throughout history as the action of nonphysical and unmeasurable processes, like a cosmic intelligence. These experiences, especially the sense of a presence and out-of-body experiences, were first created by direct electrical stimulation of the surface of the brain in the mid-20th century. We saw harbingers of our present understanding of them in the 19th century, through Hughling Jackson's insights in the area – that the brain has an electrical character, and electrical stimulation can create altered states of consciousness. Other early scientists in the field observed the body responding to electrical stimulation of the brain, even in cadavers. These pioneers in brain science showed that the complexity of consciousness, including its mystical states, could be affected by applying electricity, and they were well aware that electricity could also make things work in the real

world. [The question of whether the brain is an electronic device has been present from the very first brain stimulation studies.]

However, the subtle and complicated fluctuating electrical and magnetic energies in the brain that create (or appear along with) altered states of consciousness don't need massive currents to appear. When we apply magnetic signals, patterned after the brain's biological activity, using the appropriate timings, they can also elicit these states with real clarity, as well as powerful emotions, and a strong meaning for the person who experiences them. The field strengths are within the range of the electromagnetic fields around the modern electronic equipment in our homes and the world around us. [One of the highest geomagnetic values ever recorded, taken in Glastonbury, England, was 10 Milligauss, the peak field strength for our signals measured from the middle of the head.]

A simple metaphor reveals the implications. There is more than one way to open a locked door. You can kick it open (as with rTMS) or use a key. It takes a lot less energy to use the key, but the shape of the key must fit the lock, just as our magnetic signals must be applied with the correct timings, over the correct areas of the brain, and in the right environment. [Many of our same procedures have clinical applications. At the same time, the mental health that mysticism encourages comes from practices that invite mystic experiences. Perhaps one day the techniques we employ will find widespread use in clinics, not only to induce mystic experiences (the world's best coping mechanism), but also to make the fruits of mysticism, like calm, tranquility, and joy, available to all.]

CHAPTER FIVE

Religious and Mystical Experiences as Artifacts of Temporal Lobe Function: a General Hypothesis

Persinger, Michael A. "Religious and mystical experiences as artifacts of temporal lobe function: A general Hypothesis." *Perceptual and Motor Skills and* 57, no. 3_supplement (1983): 1255-1262.

Editor's note: This is one of the first, seminal papers. Most religious and mystic experiences involve the temporal lobes; especially it's deeper, limbic areas. That's why the God Helmet applies its magnetic signals there.

This paper was published before the rapid growth in the number of books and studies on Near-Death Experiences, and your editor has added a few comments about them. Here, the emphasis is on similarities between organic religious experiences, and the kind that happen to a few epileptics. Later, Dr. Persinger agreed with this editor that only a small minority of religious experiences are epileptic phenomena. This book reproduces a blog on the subject.

Summary – This paper presents the idea that mystic and religious experiences are evoked by electrical events in the deep structures of the temporal lobes. They are, to use a metaphor from epilepsy, "micro" seizures. [In later years, Dr. Persinger moved away from the "micro seizure" concept, and towards another idea, that the electrical activity that supports mystic experiences are the brain's organic and natural response to specific events, and in most cases, are not features of a disorder. They don't depend on seizures, but rather specific natural patterns of activity, deep in the temporal lobes. A seizure can find its way into almost any part of the brain, and when it accesses the pathways that support religious experiences, the person will have a mystic episode.] The details of any specific spiritual experience are affected by their context. [Very similar states of mind can appear in both moments of deep romantic love and in a church while praying, and although the two experiences might *feel* very similar, their very different contexts will influence the way a person remembers them and the words they use to talk about how they felt.] Religious experiences are also affected by the views, beliefs, and points of faith a

person has held through their lives. These may influence details of what a person sees or hears during such an epiphany, but not whether or not they have one [or what kind they have]. The basic themes of these altered state experiences reflect the functions of the amygdala and hippocampus, deep in the brain, as well as surface of the temporal lobes nearby them. Some events can make these brain parts temporarily share more information than they usually do, both within their component parts, and with their neighbors. When that happens, they can allow access to the memories of one's parent's from infancy, which will have shaped their expectations about God, because of the crucial role the hippocampus plays in memory retrieval. [Years earlier, Dr. Persinger had theorized that early experience with our parents created a template for our expectations of help from others. These are later projected onto God, in those who have faith in him, according to a concept sometimes called "attachment" theory.]

Stimulating the surface of the temporal lobes with electrodes has evoked out-of-body experiences, distortions of space [like seeing things as larger or smaller than they actually are] and time [such as experiencing long periods of time while only a few minutes have passed by the clock, a common perception in near-death experiences.] This same type of stimulation has also elicited powerful feelings of meaning, as well as "dreamy" states, [where a person couldn't tell if a scene they were witnessing was real or happening in a dream]. The structure of the temporal lobes, the source of these experiences, is the same in everyone. This explains why religious experiences show such striking similarities through all cultures.

There is a spectrum of spiritual experience running from "early morning highs" [to near-death experiences, including their visions of God,] and bouts of religious conversion or a powerful fascination with religious ideas. The neurological processes that contribute to increased sensitivity and responsiveness in the temporal lobes

> (including chemical or genetic factors) predispose people to mystic episodes. The most important circumstances that provoke religious experiences are personal (life) crises and confrontations with death. However, people can also learn to trigger these experiences, which happen along with these electrical temporal lobe events, as religious responses to threats against their own existence. At the same time, they trigger the brain's reward system, so that death anxiety is replaced by spiritual responses to the threat of death. These transient electrical events in the temporal lobes can also have a strong effect on human behavior, both in ordinary moments and during mystic experiences. [People also respond to less threatening stressors by turning to spirituality, and some appear to be born with a strong predisposition for mystic experiences. This can be explained as activity in places where the pathways involved in the brain's reward system are either unstable, or especially sensitive.]

[Prior to this 1983 paper], most behavioral scientists have avoided studying the neurological and psychological bases for religious experiences and belief in God. These experiences, together with our constant confrontation by the fact of death, and our uniquely human ways of avoiding the anxiety it creates, make up an ongoing type of human behavior. It's so important that only sex and aggression rival the amount of attention they receive. In this paper, we will look at the general concept that religious and mystical experiences are the normal subjective experience of specific kinds of excitement in the temporal lobes, coming either from within the brain or by events outside of it. There is a spectrum of temporal lobe sensitivity [or more simply, spirituality], and each person has a place on it. It also includes people with mental or neural disorders. A person's position along this spectrum depends on how often they have spiritual experiences, how powerful they are, and the kinds of episodes or phenomena each person encounters in such moments.

The anatomy of the temporal lobes makes them well-suited to create religious experiences. Both its outer layer and its deeper structures (especially the amygdala and hippocampus) support the sense of self, including our place in time and location in space. The temporal lobes also support our memories,

which determine what we expect from our “selves”, as well as the emotions our expectations create, especially when we’re experiencing or anticipating threats or pain. The temporal lobes have extensive connections to the brain’s language centers, so that our thoughts (the kind that use words), especially our metaphorical ones (such as we find in religious teachings), can become *suggestions* that influence spiritual experiences. This creates a comfortable context for thinking about death and our own dissolution. [A lifetime of believing that life doesn’t end with death can make it difficult to conceive of any other outcome. We hear others expressing this idea, and we find it in scriptures, classical literature, movies, and even in political and military myths, telling us that those who died for their King, country, or flag achieve a kind of immortality. If you believe that God will grant you eternal life, and you’ve believed this from before you can remember, imagining that life ends with nothingness becomes almost impossible.]

The deep (limbic) structures, especially the amygdala and hippocampus, have acquired a unique importance in human beings. Our experiences of the self and the drive for self-preservation are part of the amygdala’s larger job of deciding whether to respond to events with positive or negative emotions. It decides whether we should expect punishment and pain, or rewards and pleasure. Subtle, weak stimulation of the amygdala evokes feelings of meaningfulness and peak experiences, like feelings of cosmic communion, out-of-body experiences, and changes in the way we normally perceive our own bodies. In contrast, brute force electrical stimulation [applying electricity directly to the brain] of the amygdala tends to evoke fear and anxiety.

The amygdala and the hippocampus have complicated but efficient connections between them, as well as to the brain’s surface above them, and this allows our memories and vocabulary to control how the amygdala is working during a religious or mystic experience. [If someone has a phrase like “divine visitation” in their vocabulary, but not the word nirvana, then they’ll interpret the epiphany as coming from God and not a glimpse of their “Buddha nature.”] This allows the context and the person’s expectations and beliefs to impose details on the experience. There are plenty of opiate receptors in some areas of the amygdala and along the front end of the temporal lobe (*the temporal pole*). This allows euphoric substances, like

opioids, or the endorphins that mute our responses to life crises (like *enkephalins*) to guide these episodes toward positive experiences. Time distortions (like viewing eternity in a split-second) can also be expected during mystic experiences, a phenomenon that reflects the functions of the thalamus and the lower and inside areas of the frontal lobes (its *orbital* part) [as well as the hippocampus]. The amygdala makes heavy contributions to the sense of self, and stimulating it suddenly can change a person's sense of themselves. If the stimulation spills over into the hippocampus [a structure that functions to create and retrieve our memories], it can allow rarely accessed memories to emerge, and even create false ones. It can also give people the feeling that something meaningful and deeply personal has happened to them, even though they may not remember the details. Some of these memories might appear to lie dormant until well after the experience. [Some of them can be created after the fact, to put the neural event into a context. If someone has an episode of bliss with no other phenomena, and then remembers it later on, they may impose an intimation of God's presence on the memory, because their faith may not allow them to interpret it any other way. The memory may become available later on even if it wasn't retrieved during the mystic event.]

Temporal Lobe Physiology

The temporal lobes have unique features that also help to make them more unstable [and so more able to produce mystic and religious experiences] than other areas of the brain would be. One is that they tend to be electrically unstable for a time after they've been stimulated, whether naturally or by medical means. This longer recovery time after they've been abruptly excited is also a feature of most of the brain's deeper structures. It temporarily allows activity that doesn't match what our senses are telling us. In other words, illusions and hallucinations may incorporate memories, fantasies and points of faith into spiritual episodes and epiphanies. The temporal lobes are well known for "learning" to increase its seizures [through *kindling*, where each seizure makes the next one more likely]. On the other hand, some people have learned to *suppress* them. [Most of these seizures are unpleasant, so people are motivated to avoid them and their triggers. When unusual (but not necessarily seizural) activity in the temporal lobes creates a positive, spiritual

experience, people are motivated to engage them and seek out ways to make them happen more often, and will often dedicate everything in their lives to pursuing them, living "the spiritual life" to make them happen. [Of course, this refers to ordinary moments of contentment or devotion as well as more powerful spiritual peaks.] The triggers for negative experiences, on the other hand, are avoided whenever possible.

These areas are also prone to some types of circulation problems, like *transient vasospasms*, where issues arise in the blood flow at the somewhat isolated tip of the temporal lobe (the *temporal pole*). The architecture of some parts of our brain (like *Ammon's Horn* in the hippocampus) changed as we became humans, creating veins and arteries with shapes found nowhere else in the brain. These sensitive points in the brain's blood supply make the neurons they support more unstable than they are in other areas. These areas are a source of hallucinations and illusory perceptions, which can be woven into mystic experiences. In addition, the crevices that separate the temporal lobes from the rest of the brain (the *Sylvian Fissure*) have different shapes on each side of the brain. This means that some types of symmetrical communication between the two hemispheres (involving the same places on each of them) can actually *create* discrepancies. This can also contribute to the moments of instability in the temporal lobes which unfold into spiritual episodes.

Cells in the temporal lobe adapt to new learning and new circumstances very easily (a process called *plasticity*). The cellular membranes in this area are likely to fuse neurons together, as well as fusing neurons with the glial cells that hold them in place. This area is more likely to develop the "glitches" that cause seizures. This makes the temporal lobe a more likely starting point for seizures than other places. In less extreme conditions, it helps create unusual mixtures of cells [Which are less stable than similar cells in other parts of the brain.] These can be affected by vitamin B deficiencies, fluctuations in hormone levels, hypoglycemia, oxygen deprivation, and tumors. These unusual conglomerates of cells are particularly sensitive (they fire more easily). In some environments, they are also more likely to change their branches, and this can be seen even using ordinary microscopes.

Electrical Tremors in the Temporal Lobes

According to the hypothesis we're exploring here, the moment of an actual religious or mystic experience is also a moment of a transient (usually just a few seconds) very focused electrical activity within one or both temporal lobes. These events are called *temporal lobe transients* (TLTs). We can think of them of them as "micro seizures," remembering that this is only a metaphor. [Since this paper was published, some people have mistakenly interpreted this as meaning that we have claimed that mystic experiences are actually seizures and that technology for altered states can cause epileptic events, and pose a risk for epileptics. We offered the idea as an *analogy*, not an explanation. In fact, we published an online blog (2015) explicitly rejecting the idea that spiritual experiences are epileptic events. Religious episodes *can* be caused by epileptic events in the brain, but much more often they're triggered by powerful incidents in the world around us and organically from within our brains. Trauma, sudden tragedies in our lives, sleep deprivation and ingesting chemicals, from poisons to blissful hallucinogenic drugs, can set the stage for a mystic experience. They can even cause them directly, but not as seizures. [If religious experiences were seizures, they would come after seizural triggers, like flashing lights. Religious experiences follow the profound emotions triggered by real events much more often.]

The basis for spiritual episodes can be compared to microscopically small electrical seizures, but without any obvious body movements, although some seizural symptoms would appear, especially in the most extreme numinous states. We would also expect to find phenomena that also appear in temporal lobe seizures, like the facial expressions that go along with ecstasy or crying, automatic gestures, body movements, and jabbering speech. [If a person who experienced this jabbering speech also believed in *speaking in tongues*, they could easily suggest to themselves that that's what they were doing. The more it resembled actual speech, the more they would be able to reward themselves, interpreting it as a sign of holiness]. Many mediums and healers don't remember what they said or did while they were channeling their spirit guides, and many TL seizures are also commonly followed by amnesia. Only the most extreme spiritual experiences would take on these aspects of epilepsy, and only a small percent of spiritual practitioners, sadhus, monks and nuns, healers, shamans, and the deeply faithful are acting out true

epileptic seizures during their epiphanies. Most spiritual experiences begin in the deeper structures of the temporal lobes. However, a few of them would be powerful enough to influence activity in the surface of the brain, where they can be seen in EEGs. These are characterized by small areas (even small enough that only one of the EEG's sensors would pick it up), creating brief signals *similar* to those of epilepsy, but with normal activity appearing both before and after the event. [We could describe it as a "visible blip" in a very small area, which lasts only a few seconds.]

[The concept of "mystic experience" here includes both heavenly and hellish altered state episodes. Visits from angels and demons are both made of the same "stuff."] The details of what a person actually experiences during such an epiphany can be influenced by the place where it happens (for example, in a church versus in a public place), their beliefs about its source (God versus cosmic consciousness, or a glimpse of enlightenment) and whether it's pleasant or unpleasant. If it's a blissful experience, someone might interpret it as a glimpse of heaven, or the touch of their guardian angel. If it's an unpleasant experience, they might think it's a vision of hell, or that they're being tormented by a supernatural demon or even Satan himself. The blissful or demonic character of the experience will reflect the activity in the brain's emotional centers. If the amygdala (the brain's primary emotional center) on the left leads the experience, it tends to be blissful or ecstatic. If it's counterpart on the right is more excited, then the episode will tend to be hellish or terrifying. Ordinary mystic experiences are one of our brain's normal functions. So are the mechanisms that stop them after a few seconds. Both the brain, and the emotional and cognitive connections within our minds, are extremely flexible, and the phenomena that appear during mystic experiences are easy to weave into the "outer" self. [When an experience like this is over, people often take time to "digest" or "process" it, and afterwards, they often feel that they're now in possession of a profound "truth" which has "healed them" or "made them whole." They've become a new person, and are often irritatingly sure of themselves.] More elaborate and bizarre perceptions in these experiences, especially fear or a feeling of evil, happen when they spread to other areas in the temporal lobes. Stripped of their inhibitions, the core "spiritual brain parts" become unusually sensitive to input from other areas, both during and after spiritual experiences. We also see this type of

“hyper-connected” brain tissue in epileptics. We have seen that stimulation using magnetic signals can also make such experiences more phenomenal [meaning that they show a wider *range* of phenomena]. In these circumstances, people can become aware of perceptions they would normally “tune out”, which can make religious epiphanies even more complicated. [Body sensations, so subtle that we never notice them, can be amplified into strong sensations so religious experiences often have a “body ethos,” like a feeling of languid peace and calm or excited, aroused strength, and in negative experiences, involuntary cringing, tremors, or physical revulsion. People who have had spiritual experiences often want to “interpret” the details of their experiences, because they expect that understanding the details will give insights into their life’s purpose. However, some of details are little more than “neural noise,” which can’t really be interpreted in this way.]

Although the *content* of religious epiphanies usually reflect a person’s private religious history, such as what religion they learned as they grew up, (attributing the experience to Shiva versus the God of Abraham and Isaac). There are patterns in these experiences; consistent themes found in every human culture. [Their cross–cultural similarities appear] because temporal lobe functions are the same all over the world. [It may be that a visit from an earth spirit seems very different from the apparition of an angel, but the same patterns of activity in the same brain parts support both experiences. Chocolate cake is completely different from spaghetti, which in turn is nothing like a Chinese steamed bun. However, all of these are made from wheat, and all contribute the same carbohydrates. When you compare them based on their carbs, they’re all much the same, and they become different foods only after a chef processes them, just as individual minds process the same kinds of neural events, creating wildly different experiences from the same raw materials.] The common patterns of the experiences mystics (and people who’ve had near-death experiences) report reflect the pathways involved in the experience, as they make temporary connections between structures that usually don’t interact. Even memories we can no longer retrieve (like those of our parents during infancy, memories of how our bodies felt before and after we were born, and images from before the age of five) could become involved in the experience, though they may not show

themselves to the person the way memories usually do. They would seem to come from outside ourselves (be “ego-alien”). These usually unattainable memories would instead be integrated into their larger mystic experience, where they would make more sense [because they’d be connected to more areas, and each one would lend them another context]. Fragmentary memories of one’s parents, reacting to one’s needs as an infant, might include the ethos of being taken care of. Later on in life, the person “feels” that they’ll find the same thing in God. For example, pictorial memories from before the age of five could similarly be reworked into some of the raw materials for the experience of a past life, or existence in “another dimension”. [Cultivating the art of “past life reading,” might refine this rudimentary mechanism into a cognitive skill. It wouldn’t matter if the insights found this way are true or not, provided they “feel right” to the person receiving the reading.]

Electrical Stimulation of the Temporal Lobes

Spiritual experiences with multiple episodes or phases, like near-death experiences, are different from the more ordinary kind (with a *single* vision or profound insight). Each different episode or phenomenon recruits different structures or areas (or groups of neurons) into the experience. Otherwise, they’re much the same as any other. Because these are primarily positive experiences, the roots of mystic experiences must tap some of the brain’s reward mechanisms and pathways, and draw some of its content from them, especially their positive or negative emotional tone. All of these experiences have been evoked, to some extent and in fragmented ways, by crude electrical stimulation, using a pen that stimulates the surface of the brain with a low electrical current during surgery. This kind of stimulation has created out-of-body experiences, sensations of movement while the patient was actually keeping still (*vestibular* sensations) like spinning, or being uplifted. It’s also brought out inner sounds (like rushing noises, hearing someone call their name, or the words of a spirit being, conveying higher religious teachings), visual phenomena, (like looking down into a tunnel, seeing bright lights, or seeing into infinity), and spiritual emotions, like joy or profound peace. The experiences may seem to be very similar to dreams, or be “not of this earth.” Since the collections of brain cells that also support the sense of

self (“myself”) are usually recruited into the experience (because of their low firing thresholds), these episodes have powerful meaning for the person who has them. They’re intrinsically private, and often cannot be shared with others. The insights and transformations they create protect their own privacy. [Some mystics feel that their spiritual experiences are too sacred to be shared with others or that they’re meant as “private revelations,” or reserved for a “chosen few”. Others want to shout their insights and revelations “from the mountain tops”.]

The Temporal Lobe Personality

We agree with previous researchers who tell us that there is a temporal lobe personality “type.” We can think of it as a (usually healthy) syndrome that appears when activity in the brain parts that support mystic experiences also drive and motivate much of the person’s day to day behavior. [To put it simply, the brain parts and pathways that support the experience of God’s presence are also very likely to guide the person towards “godly” behavior at other times. Seeing God or having the feeling that “he is with me” can drive a person towards ever more careful morality and more scrupulous ethics, depending on their religious beliefs. Unfortunately, repeated, intense, and hallucinatory religious experiences can also be expected to create strong delusions, and even some destructive behavior.] There are other extreme and bizarre expressions of unusual activity in the deep temporal lobes, like *circumstantiality* (the tendency to ramble off course and away from the point at hand in conversation [“the professor’s curse”]. We also see traits like exaggerated self-importance, as some mystics become obsessed with their “mission,” becoming convinced that they’re being guided by a divine purpose. They also show a trait sometimes called *viscosity* [“resistance to change in flow”], that can leave them fixated on a few actions, or a very few issues or subjects, usually related to the crucial ideas in their religious beliefs. They can have trouble talking about anything else. Another trait of the “temporal lobe personality” is *hypergraphia*, the tendency to write at length, whether in diaries or journals, or novels and channeled scriptures. The same trait can also be expressed through painting or drawing. [People with very sensitive temporal lobes often have rich inner lives, and writing out their thoughts and feelings seems to be fulfilling for them; more so than for the

general population [“most folks”]. Mystic experiences give people new frames of reference for themselves and the world around them. Lifetime emotional habits (such as what does or doesn’t make them angry) can change in just a few seconds; because the same brain parts that support our primary emotions (e.g. the amygdala) also contribute to the sense of self. When neural pathways that support bliss become disinhibited, the person will naturally be more blissful. Principally, this refers to the amygdala on the left side of the brain. However, the same structure also makes substantial contributions to anger and irritability. [Some mystics, like the Florentine Girolamo Savonarola, who had visions of hell, and heard the angry voice of God condemning the sins of his day, might become “fire and brimstone” preachers. Their left hemisphere supports an angry God instead of a God whose presence invokes bliss and joy. Instead of encouraging people to find happiness and virtue, they encourage fear, the avoidance of sin, and sometimes hatred of sinners. At different times in history, all these beliefs have served to encourage socially adaptive behavior, but in some cases, they’ve fostered mass slaughter and destruction.] In fact, people with very sensitive temporal lobes often find that religion and spirituality is an overwhelming concern for them, a trait known as *hyperreligiosity*. These traits appear as symptoms of the *interictal* (between seizure) behavioral syndrome of temporal lobe epilepsy, and also as ordinary personality traits in people who have ordinary (non-epileptic) mystic experiences. [Whether these are syndromes or personality traits depend on how much they dominate someone’s personality, how intense they are, and whether or not they motivate destructive delusions. True epileptics with religious experiences are more likely to show some, but not all, symptoms of schizophrenia or “*temporal lobe psychosis*”, and find that their experiences happen in response to the same trigger, over and over again.]

Typically, they have early morning peaks (1:00 am to 4:00 am) in their creativity and energy. They usually experience déjà vu, and sometimes feel rapid or very slow vibrations as they fall asleep, like “waves of energy running through the body,” as well as recurring vivid dreams. They would also find intense meaning in [seeing films and] reading about otherworldly experiences, especially spiritual ones. They can also be expected to have occasional feelings that either they or the world around them isn’t real, as

well as peaceful episodes where their mind seems especially quiet, without any urge to concentrate or focus on anything. They‘re also likely to have memory blanks, feel the presence of other beings around them, and see signs and omens in random events, and sometimes perceive events before they happen, or at least remember doing so. *These are normal in people who have religious and mystic experiences*. They don’t dominate the person’s behavior, and don’t last as long as pathological behaviors and ways of thinking. If we imagine a spectrum of religious experience and involvement in spirituality, we would find most spiritual seekers in the middle, and that they display temporal lobe signs, but don’t have any disorders in their thought processes. Where a schizophrenic “religious nut" might be obsessed with a particular theme or idea, a normal mystic will only be fascinated, and will usually see when their ideas and beliefs won’t apply or won’t be understood by those around them, [so they’re a lot less likely to proselytize].

Triggers for Spiritual States and Experiences.

A variety of factors, some of them quite flexible, combine to choose a person’s place in the spectrum of temporal lobe sensitivity. Those with the kind of compromised spots in their temporal lobes that create seizures (“seizural loci”) will be among the most sensitive. As people grow up, and their brains go through their normal development, they may become more prone to spiritual states, or find that their sensitivity wanes as they get older. There are times in a person’s life when they’re more likely to have religious experiences. Puberty is one such time, as the temporal lobes of the brain become more sensitive while they rewire themselves to bring the child into adulthood. The peak risk period for pediatric temporal lobe epilepsy hovers around eight years old, when the temporal lobes are undergoing a growth spurt. [Actively growing brains are more sensitive than fully grown and stable ones.] Something similar happens in geriatric brains as they deteriorate, whether from dementia or anything else. Anything that increases sensitivity of the brain’s deep structures, including spiritual practices, like meditation or becoming engrossed in prayer, can make it more prone to religious and mystic experiences.

In general, the more intense the event, agent, or pathology that makes a person sensitive to mystic episodes, the more complicated and vivid their

experiences will be. Lots of things can precipitate these experiences, if a person is sensitive to them. Milder stimuli include fatigue, solitude, early-morning creative peaks, jet lag, the right music, incense, and rocking movements, from gentle movements in prayer to “trance dancing”. These things can either be combined in a person’s daily routine, or created during religious ceremonies and rites. Of course, there are stronger ones, like fasting, oxygen deprivation (“praying from the mountaintop”), psychedelic drugs, intense pain (including childbirth) and intensive spiritual practices like *kriya yoga* or prolonged meditation. Nevertheless, the person’s overall sensitivity is more important than their response to their specific triggers.

Grief and Dying

Intense death anxiety and grief are perhaps the most powerful states for provoking religious experiences. Moments of death anxiety happen more frequently with age, as the person gets closer and closer to their inevitable demise, and this can generate obvious religious experiences in deathbed patients (like hearing a voice say, “You will live forever”). Grief is often followed by episodes that relate to the person we’ve lost, such as visions of the person who died, usually interpreted as their ghost, and very often giving messages of comfort (“I’m here, waiting for you on the other side. I’m fine. Don’t be sad. Everything will be okay”). Both of these kinds of spiritual catalysts appear as solutions to the crisis of either one’s own death, or the pain of living without a loved one. These experiences feel like they’re absolutely real, and they’re intensely personal, containing messages that are *only* meant for the person who sees, hears, or senses the apparition.

Perhaps the most powerful invitations for religious and mystic experiences come from the physiological and psychological states that appear when we’re close to death. As it approaches and blood flow is reduced, spasms in blood cells (“vasospasms”) in key areas of the brain make these experiences more likely, and they can continue for a long time. [In some cases, premortem visitations (where the dying person has visions of spirits waiting for them “on the other side”) can appear days before the person actually dies. [Interestingly, episodes where the bereaved is visited by the spirit of their lost one are most common a few days after they’ve passed on.] The body’s natural deterioration, and the surgical procedures (including

anesthesia) often carried out in a last ditch effort to save the patient, also create conditions that can prolong both instability and sensitivity in the temporal lobes. Religious experiences that appear during the death process can last much longer than the few seconds that more ordinary spiritual experiences usually do (unless epilepsy or schizophrenia is involved). We should take note that EEG brain monitoring techniques really only cover the outer 1 or 2 centimeters, and can't tell us what's going on in the brain's deeper structures. We know that they respond to stimuli easily. For example, noises or changes in the lighting of a room where a person is sleeping can elicit an EEG response, even when they're in dreamless sleep. That's about as close as most people can get to being unconscious without an injury or "insult" to the brain. When the contributions from the brain's outer layer to the limbic system are reduced, as we expect during the death process, activity in the brain's deep structures will be highlighted and accentuated. Our awareness would be filled with their activity, and this would tend to make the experiences even more intense. The outer layers of the brain (the *cortex*) "contain" much of our personalities, emotional expressions and intelligence, and they show the greatest difference between individuals. In contrast, the deeper structures show greater similarities in their functions. The experiences that appear for people in otherwise very different cultures will be quite similar because the limbic system takes over as the outer layer of the brain shuts down during the death process. Deathbed experiences will also be influenced by drugs that affect the amygdala or influenced spasms in veins and arteries. [A Muslim seeing God during a near-death experience may hear different words, in a different language, but they will still hear words spoken to them by divine beings, just as happen in near-death experiences among Christians. As believers in a formless God, they are very likely to "see" Him as a blast of light, positioned in a very large space (such as the "halls of heaven" or suspended in outer space as we sometimes see in the near-death experiences of Western countries). Even religions that assign God a concrete appearance will often find its believers seeing a formless God during mystic experiences.]

Mystic experiences are intrinsically rewarding, and many mystics learn ("condition" themselves) to make them to happen at will. With each spiritual episode, the person finds that their anxiety is reduced, and they become more

attached to whatever stimuli provoked them as well as any beliefs it encourages. People whose brains are prone to stimulating themselves (as in epilepsy or bipolar disorder) are more likely to have frequent insights, followed by long periods with regular mystic episodes, each one amounting to a minor or complete religious conversion. This can happen in patients with temporal lobe psychosis. Spiritual experiences are intensely rewarding, so anything that leads up to them is reinforced. In more pathological cases, even personal crises or difficulties can become rewarding, because the euphoria of spiritual experiences can continue even after the epiphany is over [changing from elation to gratitude]. These patients are prone to occasional bouts of religious conversions, mania, explorations of cults and obscure religious sects, and will often rededicate themselves to their spiritual goals in the aftermath of a fresh mystic episode.

All human cultures preserve techniques ("spiritual disciplines") that make it easier to attain mystic experiences. Most of them are selected and preserved according to how effectively they elicit mystic experiences. Actions and behaviors that increase temporal lobe sensitivity include "forced thinking," like repeating sounds or prayers over and over (including mantras), relaxation techniques, meditation, and dietary changes (like fasting). Specific environments, like churches, temples, or gatherings where groups all practice the same spiritual technique together (like vocal prayer, participation in a liturgy, or Sufi dancing) can also contribute. There are many forms of group participation, and each one can be effective in helping to achieve religious "peaks" (not only the technique itself, but also the simple conversations with others ["fellowship" and *Sangha*], where beliefs are shared in common, and people reward each other for participating, giving one another a kind of approval that's rarely found outside the group).

The blissful and meaningful content of religious experiences reduce existential anxiety and generate a kind of security that echoes early experiences with (good) parents. In the right context, a single episode can be followed by lasting positive changes in a person's behavior. However, anything that threatens to undermine these experiences, or the beliefs that support them, can make the person afraid or irritated. Behavioral scientists are no exception to this rule, which may explain why the neurological and

psychological basis of religious experiences has received so little attention from them. [This has largely changed since this paper was first published in 1983, though the field is still in its infancy.]

Human beings, at least some of us, need mystic experiences. [Not only do the brain changes that follow them provide additional ways of thinking within a social group, so that some of us have more intuitive ways of thinking ("cognitive styles") than others]. They also generate concepts and ideas that sanctify ordinary human activities and provide a context for preserving successful behavior, especially in our early evolutionary history, [as well as contributing ideas that reduce death anxiety to their culture.] This need probably grew in tandem with the development of our frontal lobes, which made our brains, and our ways of thinking, so complex that we were capable of finding questions that our ordinary experience couldn't answer, [like "what will happen when I die?"] The evolution of human intelligence and our sense of self would not have happened without these buffers against the ever present possibility of death. The human self had to find a way to think about its own nonexistence, to remember it each time it might be threatened, but without it being stressful. Our frontal lobes evolved, making us more able to anticipate and avoid threats to our survival. As failure entails death, it becomes a constant component of all plans and strategies for survival. The way our species resolves the "threat" to existence itself is through the postulate, axiom, or involuntary assumption that death is not the end of consciousness. All the world's religions, from shamanistic and animistic faiths to the elaborate scriptures of classical religions, hold this belief in one form or other. Adding religious beliefs to our cultural milieu would have allowed each person, even those who aren't prone to mystic experiences, to have serviceable answers to life's existential questions. In the absence of competing ideas to the contrary, each person, regardless of their intelligence or rationality, would have found comfort in the religion of their culture. To put it simply, the shaman would tell people that death is not the end, and that it's nothing to fear. They would speak on the authority of their own personal experience, and in the absence of any evidence to the contrary, or even ideas that contradicted the belief that life never really ends, even the most critical of our early ancestors would have accepted it. [Moreover, because these views are shared in common throughout a culture, it would have been

difficult for such a skeptic to achieve any significant social rank, like being a chief, or an influential member of a tribal council. Contradicting the most commonly held views in a culture is usually a path to rejection, not respect, within a tribal group.] Although the evolution of religious and mystical experiences may have helped us to survive in our early evolutionary history, their continuation in the context of today's religions can have ominous implications. [Whereas a shaman, in the first generations of humans, might have told their people what they learned during an epiphany, their "vision" would lose its impact with the passage of time and generations. Today, our religions are based on scriptures that don't change, and they're often supported by individuals who maintain that their insights, rules, and forms of worship are valid at all times, and for all people.]

If these "temporal lobe transients" are the source of religious experiences, then four issues appear for us. First, some of these portions of the brain are also correlated with aggressive behavior. Second, because personal meaningfulness is always a part of religious experiences, we have to ask if there is a genetic tendency to eliminate "nonbelievers," backed by the conviction of divine consent that appears with some kinds of mystic experiences. [The answer appears to be no, unless there is strong social or cultural conditioning that encourages people to do so.] Third, because many religious behaviors are correlated with an opiate-like sense of complacency, helplessness in the absence of divine deliverance, and the expectation that such help will appear in times of trouble, we have to wonder if religious and mystic experiences can influence decisions in people who hold political power. Fourth, if spiritual epiphanies are based on patterns of brain activity, we should expect that they can be stimulated and induced by modern technology. If they can be evoked artificially, what are the clinical implications for controlled religious experiences? [On the one hand, it may be possible to induce them in clinics and hospitals to alleviate psychiatric disorders.] These issues appear as immediate consequences of the idea that we've explored in this paper; that religious and mystic experiences rely on certain patterns of brain activity, focused in the temporal lobes, which all humans share in common. The basis for spiritual experiences is the same for everyone, so that all of them have certain points in common, [even though the actual content of these experiences can be as different from one another as a

snowflake or a fingerprint.]

CHAPTER SIX

Out-of-body-like experiences are more probable in people with elevated complex partial epileptic-like signs during periods of enhanced geomagnetic activity: a nonlinear effect.

Persinger, M. A. "Out-of-body-like experiences are more probable in people with elevated complex partial epileptic-like signs during periods of enhanced geomagnetic activity: a nonlinear effect." *Perceptual and Motor Skills* 80, no. 2 (1995): 563-569.

[Editor's Note: The data analyzed in this paper was gathered during several studies, carried out over three years, and is not from any single experiment.]

Summary: Over three years, 128 men and women who had a single [God Helmet] session in Dr. Persinger's laboratory reported having felt they left their body. All of them had completed questionnaires [weeks or months before the experiment] that showed their individual levels of sensitivity to altered state experiences. The individuals who were found to have out-of-body experiences ["OBEs"] during the procedure were also found to be more sensitive to other kinds of altered state experience. The study found that these primarily occurred when the geomagnetic activity was in its middle range [elevated, but without a geomagnetic storm], between .16 mG and .45 mG (Milligauss).

We began with the idea that that all subjective experiences, no matter what they might imply when they're interpreted through someone's culture, spirituality, or religion, are associated with specific kinds of brain activity. Most commonly, we experience our awareness as being a part of ourselves, one that exists in our bodies. We can think of things like depersonalization (when one loses their sense of identity), detachment, and OBEs as moments when it feels like the sense of self isn't located in the body. These are such ordinary experiences that believing that one's body and mind are two separate entities becomes [self-evident] common sense for those who've had OBEs, [though it assumes that one's own experiences are an infallible guide to how the mind works – they're not, of course].

Interestingly, one of the brain areas implicated in OBEs, in the area where the temporal lobes meet the parietal lobes [2 to 3 inches above the ears], is also associated with seeing ghosts, spirit beings and doppelgangers.

OBEs are associated with temporary changes in the way the temporal and parietal lobes of the brain are working. Someone can become prone to OBEs if they lose enough neurons in this area because of a brain injury or some other trauma. They can also be associated with subtle changes that are only seen if you look for them in EEG data. The EEGs of people who have OBEs have been found to have differences in alpha activity, even though they may not have a history of brain injury, and there's no reason to think that their brain has been compromised. These episodes, which affect the way a person experiences their own mind and body, are well (but not completely) correlated with people's score on a questionnaire that asks how often they experience common, everday, altered state sensations (like déjà vu, sensing a presence, feeling movement when the person is staying still, and emotional tingles). These also happen in the course of Temporal Lobe Epilepsy (TLE). In fact, they're called "complex partial epileptic signs", because they happen a lot for people with TLE, with its "complex partial" seizures. [They also happen for lots of people who aren't epileptic at all, but they were first identified as a single group of experiences by researchers who were studying TLE.]

[The concept of *vectorial hemisphericity* is the idea that all or most brain functions aren't 'left-brained' or 'right-brained' but are actually 'vectors,' drawing on areas on both sides, but not equally. It's similar to the way an airplane's route can be a vector of east and north without ever going *exactly* in either direction. Most of the time, a 'right-brain' function is only *dominated* by the right side of the brain. It will also reach across the brain for contributions from the left side]. *Vectorial Hemisphericity* predicts that the experience of being out of the body appears during (usually temporary) conditions that distort the normal communication between the temporal and parietal lobes on both sides of the brain.

This kind of event is more common than most people realize. People often dream scenes woven out of their normal memories, but from an out-of-body perspective, and we also remember events, seeing ourselves in our memories, even though we weren't having an OBE at the time. They never actually saw them selves from the perspective they remember it. Most memories where we 'see ourselves in our mind's eye' are fabrications.

Disturbances in the normal communication between the hemispheres appear to come from the limbic system, especially in the hippocampus and

amygdala, deep in the temporal lobes. These areas have the lowest electrical thresholds in the brain, and appear to be especially sensitive to changes in the amount of melatonin at work there, and this brings us to the fact that melatonin's behavior is very sensitive to faint magnetic fields, especially when these fields rotate. Interestingly, geomagnetic activity also has circular pulsations.

Several researchers have reported that the thresholds for epileptic seizures go down as the earth's magnetic fields gets busier.

OBEs should be most likely (for people who don't have epilepsy) during times of mid-range (*elevated*) geomagnetic activity, if they have a history of altered state experiences [i.e. *Temporal Lobe Signs*]. The experiment in this paper was designed to test two hypotheses 1) that the right amount of geomagnetic activity makes the brain more sensitive to changes in the connections between the two hemispheres, and 2) these changes have an impact on how sensitive a person is to altered states of consciousness.

Method

From 1989 to 1991, 128 men and women received 30 minute brain stimulation sessions, applied over the temporal lobes. They received a magnetically applied signal to the left, right or to both sides at once, while they sat in a big comfortable chair, in an absolutely silent chamber [which was also a vibration-proof Faraday cage (which shields it from EMF pollution, so that a cell phone won't get any signal, but a compass will still point north)]. They wore dark goggles that blocked out all light. At the end of the session, the subjects took a questionnaire that asked about 20 experiences or sensations, inquiring if a given experience 1) didn't happen during the session, 2) happened occasionally, or at least once, or 3) appeared frequently. One of the items said "I felt as if I had left my body or was detached from my body". Another item said "I felt as if I were somewhere else". The first of these items asked them if they'd had an out-of-body experience, and the second one was intended to ask them if they had felt dissociated, depersonalized, or just "absent". [The words "out-of-body" don't always mean the same thing to different people, so we used a 'control question'.] The measures for whether an experience happened often during the session, occasionally, just once, or not at all, were compared to their scores on the TL signs questionnaire they had filled out anywhere from two weeks to two

months beforehand. Records for [the average] global geomagnetic activity were used to find out how active the earth's magnetic fields were at the time of the experiment (the geomagnetic data is quite exact. The levels for the earth's magnetic field are measured every three hours), and we also recorded the geomagnetic levels during the three hours before, during and after each session. [This is a standard protocol for many of our experiments.]

Results

[Approximately 36% of those with elevated temporal lobe signs and who received the stimulation had OBEs when the geomagnetic levels were elevated. Extrapolating from other studies, the same number would be approximately 4% in the placebo condition.]

There is evidence that the relationship between the sense of self and consciousness involves subtle and complicated processes within narrow sections of the total neural activity in our brains. [Let me use a metaphor here. Watching all the activity in the brain can be compared to listening to an orchestra with all the instruments playing at once. Looking at the sense of self would be like only paying attention to the piccolo. Lots of things are happening, all the time, but only a little of it is busy 'playing' the sense of self.] If only a few of the many pathways involved in human consciousness also support the sense of self, then making changes to it (in this case, your feeling for where *you* are located) using stimulation with magnetic signals will rely more on their *information* in them than the *strength* of the field. Any effects associated with the earth's magnetic field will be "nonlinear" [they won't match up with just one 'volume' or level for the earth's magnetic field]. The *strength* of the geomagnetic field will be less important than the specific kind of turbulence or currents happening in it.

Some geomagnetic phenomena [or instruments in our geomagnetic orchestra] will have an influence on the brain, and others won't. If the brain's electrical and magnetic processes respond to the stimulation, then something, perhaps too subtle for a person to feel, is going to happen. It's much more important whether or not the earth's magnetic field is saying something the brain understands [so to speak], than it is how loudly it seems to say it. Further, each brain has a different sensitivity to altered state experiences.

The relationship between 1) consciousness, 2) the sense of self, and 3) the earth's magnetic field is easiest to see when we look how changes in

consciousness [or *state* of consciousness] appear in different circumstances. We probably won't find an *exact* correlation between a specific state of the earth's magnetic field and out-of-body experiences, or any other specific effect it has on consciousness. Remember that geomagnetic events make these experiences more likely, and that's not the same as causing them. [We also can't expect to find a magic signal that will *force* a person into OBEs. Such aggressive stimulation could create negative effects.] Other studies have shown close connections between elevated geomagnetic activity and how the brain manages our homeostasis (the balance between the body's systems), when the daily geomagnetic activity goes above a certain point. [Increasing one's chances for an OBE is not the only effect the earth's magnetic field has on the brain].

We found a significant match between 1) a history of altered state experiences and 2) the geomagnetic activity on the day of the experiments and 3) the frequency of out-of-body experiences for the 128 subjects. The subjects who had the largest number of everyday altered states reported significantly more intense and more frequent experiences of being out of their body (while receiving the magnetic signal stimulation) than the ones who had fewer altered state experiences on days of enhanced geomagnetic activity.

The most *intense* of these experiences were reported primarily (by those subjects who were most prone to altered state experiences), [and had the personality traits that go with them) on the days when the geomagnetic activity ran between .16 and .45 *nanoteslas*. [These are elevated levels, but not active enough to be a geomagnetic storm. We could call them mid-to-upper-range levels.]

The results of this study support the idea that sensitivity in the parts of the brain most responsible for altered state experiences also makes them sensitive to some part of the earth's magnetic field, but only when it's above a specific tipping point, not at its most extreme peaks. You can think of this as a *window effect*. The window is between geomagnetic quiet (too little) and geomagnetic storm (too much). The brain doesn't seem to be responding to the *strength* of the earth's magnetic field, but rather to some information or pattern embedded in it. It seems likely that the "effective" range for the earth's magnetic field, where it contributes to out-of-body experiences, will be one where it produces at least some information that the brain responds to. Of course, the earth's magnetic field existed eons before the brain existed, so

that the brain, with its electrical and magnetic systems, may have evolved to use the earth’s magnetic field adaptively, and even use it to augment some of its functions.

The OBEs were strongest when earth's magnetic field had these [mid-range] measures late at night the day before the subject got their session, or early in the morning on the same day. This suggests that the geomagnetic field may influence [states of] consciousness for up to a day. The fact that most of the subjects would have been asleep during the night before the experiments suggests that their out-of-body experiences may have been "primed" the night before, and then *appeared* during the experiment. The sense of self may involve no more than 1% of the brain's normal operating voltage. It’s possible that the neural processes that generate it are coherent [like a bolt is coherent with the nut it fits] with the earth's magnetic field or may depend on one of its unknown features. Variations in the earth's magnetic field could disrupt this normal connection between our consciousness and the earth, and then we’re more likely to feel like it’s separate from our bodies [so we can find ourselves out of our bodies]. [In either case, it's possible that parts of each person’s mind rely on the earth’s magnetic field for at least part of its existence, though perhaps less often for some than for others.]

[We should take note that this study does not prove (or claim to prove) that OBEs are ‘real’ (*veridical*), meaning that OBEs are exactly as the person interprets them; with consciousness being separated from, and existing outside of the body. It also doesn’t prove that they are illusions or hallucinations. Nor does it prove that some are *real* and some aren’t. It examines the interaction between the earth’s magnetism, a history of common altered states, and specific signals applied to the brain through magnetic coils.]

CHAPTER SEVEN

Experimental facilitation of the sensed presence : Possible intercalation between the hemispheres induced by complex magnetic fields.

[A placebo-controlled, double-blind experiment.]

Persinger, Michael A., and Faye Healey. "Experimental facilitation of the sensed presence: Possible intercalation between the hemispheres induced by complex magnetic fields." *The Journal of Nervous and Mental disease* 190, no. 8 (2002): 533-541.

Editor's Comment - Intercalation: For our purposes here, we can define *intercalation* as integrating part or parts of one process into another. We could re-write the title of this paper as "Facilitating the sense of a presence by using complex magnetic fields to push right hemispheric information into the left side of the brain."

Summary: This experiment was designed to test whether the sensed presence, the feeling that there is someone, or a conscious being nearby when a person is alone, can be created in a laboratory. Using placebo controlled, double-blind experimental procedures, 48 men and women, working or studying in a university, were given stimulation using complex (pulsed) signals, applied using low intensity magnetic fields (measuring between one and

> ten Milligauss inside the head). These were applied for 20 minutes, over the right temporal lobe, the left temporal lobe, or across both temporal lobes. A fourth group of subjects were given placebo ("sham" fields, with zero field strength) stimulation. The subjects wore opaque goggles in a very quiet (acoustically silent) room. [All subjects were also taken through a hypnotic induction technique prior to the magnetic stimulation.] The subjects who received the stimulation over the right side of the brain or equal stimulation across both sides reported sensed presences, fears, and odd smells more often than either the subjects who received stimulation over only the left side or the control subjects, who received the placebo field. Our results suggest that the sensed presence can be evoked in the lab. This laboratory procedure could be used to explore the idea that the sense of a presence reflects one of the properties of the human brain, and is the foundation for the group of phenomena traditionally explained as visits from the gods, spirits and other nonphysical beings.

Today's brain science predicts that all experiences, from writing computer code to falling in love, are associated with specific activities in the brain. Several researchers have created experiences by applying small electrical currents to specific places in the brain, yielding results that agree with this principle. We've been developing experimental ways to modify neural activity by applying low intensity magnetic signals to the head. The original purpose of this research was to understand the neural electrical and magnetic foundations for the human sense of self. Our experiments have shown us that applying magnetic signals with specific shapes over the right side of the brain can create the experience of "another consciousness" in most healthy, right-handed people.

We've suggested that the sense of a presence, or the feeling that there is an entity or sentient being appearing close to a person, has been found all through history, and in every human culture. Our hypothesis tells us that the "presence" is possible because of the way the two human brain hemispheres

are organized. It also tells us that this experience is one of the raw materials for more elaborate experiences, like the visits from the gods, aliens, and other "spirits". [We can understand the sensed presence using the concept that there are two "selves" (or more accurately, "senses of self") in the human brain. One of them, which supplies our default identity, is on the left side. The other one, which we're rarely aware of, is on the right side of the brain. We offer the hypothesis that the neural basis for the sensed presence consists of the left hemisphere's sense of self receiving excess input from its counterpart on the right side, temporarily forcing it to perceive the right hemisphere's "version" of itself. The right hemispheric "self" is projected outward and feels like a being separate from ourselves. To a large degree, the "self" based in the left side is shaped and controlled by the language centers found there. It's the one that responds to the words we hear, and feels that our words are "mine." The simple sense of a presence is the mildest example of a "visitor experience". [More intense versions of the same experience can unfold into an apparition, a spirit visitor, a messenger from a divine source or from another dimension, but these are all taken as manifestations of part of our own, somewhat complicated, "sense of self" operating out of the right hemisphere.]

We should expect that the details of any specific experience of God, Ganesha, angels, or spirits are partly determined by the words we use to think about them. Further, these words ("verbal labels") also have a strong influence on the way people remember such experiences once they're over. The rich details associated with memories of the experience of either a nonphysical being, or a simple sense of a presence, are influenced by the same memory processes that help us remember anything else. [We don't have special ways to remember special events from our lives ("autobiographical memory"). We use the same memory mechanisms for most things we recall.]

The electrical, magnetic and metabolic brain activity that creates the sensed presence must be constantly prevented. Without this constant inhibition, the experience would go on at all times. Our working assumption has been that it's impeded by specific inhibitory synapses in the corpus callosum (the neural superhighway with most of the connections between the two hemispheres) and another, less well-known structure, the *dorsal*

hippocampal commissure, which connects the left and right hippocampus.

Two of our ideas help us to see the relationship between the *sensed presence* and the sense of self. 1) The two sides of the brain are kept partially insulated from one another during normal states of consciousness. 2) The two hemispheres work together to support and create the normal sense of self as well as our ordinary self-awareness. In our model, the sensed presence is experienced when the portion of the self tethered to the right hemisphere intrudes into (or "intercalates with") the sense of self generated through the left hemisphere. During the brief periods when this happens, the sense of self maintained in the right hemisphere is both accessed and integrated with normal left hemispheric activities. [The left and right "selves" intermingle, but the one on the left is still the lead dancer.] We have assumed that when this happens, it would feel like the separate consciousness or "other being" that many epileptics feel in the first stages of their seizures. We're willing to conclude that the presence that appears for epileptics is the same phenomenon as the sensed presence [or the feeling of "being watched, or the sense that one is "not alone"] in normal people.

Our concept of vectorial hemisphericity [which says that most, if not all, brain functions involve both sides of the brain, but usually, they are primarily supported on one side or the other] predicts that any events or procedures that raise the coherence between the two senses of self on each side of the brain will also encourage the sensed presence. There are ["built in"] differences in the metabolism of the two sides of the brain, and these encourage the two hemispheres to interject activity into one another in certain circumstances, making the sensed presence more likely. These "asymmetries" in the metabolism of the two hemispheres include differences in the experiences "ruled" by them, as well as disruptions of the normal working symmetry of the two sides of the brain. We see one example in the reduced function [metabolism] in the left (but not the right) frontal lobe we find in many types of psychological depression. We expect to these kinds of "intrusions" [where processes that are usually localized to the right hemisphere "intrude" into the left] when metabolic activity on the left side of the brain decreases relative to the right. This includes times when we feel drowsy or we're in the hypnagogic ("twilight") state, prior to sleep, and also with personal stress

strong enough to trigger the brain to release compounds (like Corticotrophin Releasing Factor; a stress related chemical which helps produce cortisol) that tend to increase electrical activity.

This experiment was designed to test the idea that applying complex magnetic fields across both temporal lobes equally or only over the right hemisphere would increase how often subjects felt the sense of a presence, compared to the same stimulation only over the left side of the brain, or to a placebo stimulation. If the experiment affected the processes arising from right hemispheric activity that support the sensed presence, then we should expect to see more negative sensations, (like mild apprehension or fear) more often than other sensations, such as vibrations or visual imagery. [This is because the amygdala on the right side is more sensitive than the structures that support mental images or the feeling of vibrations, primarily the right hippocampus and caudate nucleus, respectively. Further, the amygdala, an emotional brain part, is specialized for fear on the right side, and it's the most sensitive part of the brain, so it responds to the signals more easily than other structures. We should take note that the procedure described in this experiment isn't the same as the one that eventually emerged as the most effective for eliciting spiritual and religious experiences].

Methods

Subjects

24 men and 24 women, between 19 and 25 years old, participated in the study. All of them were right-handed. They were compensated with a 2% bonus mark for the final grade in their first year psychology course. The volunteers were told that the experiment was concerned with relaxation, and were not told about the types of phenomena they might experience.

Laboratory technicians

The laboratory technicians were not aware of the purpose of the experiment, having been told that it was concerned with hypnosis and relaxation, and they didn't know which subjects received the stimulation and which were in the control group until after the subjects had completed all procedures. At the time of the experiment, the experimenters didn't know

(were kept blind to) the subject's scores for questionnaires (asking about their previous experiences with the sensed presence, among other things) which had been administered in a classroom months before.

Procedure

Each subject was placed into one of four groups. 1) The placebo group, 2) left hemisphere stimulation, 3) right hemisphere stimulation, or 4) stimulation over both sides. Each group had equal numbers of men and women. Only one received the stimulation at a time, and no more than three were tested on the same day. Their participation form said that they may or may not be exposed to a magnetic field less intense than fields emitted by a hairdryer.

To help the subjects relax, they were seated in a comfortable armchair. The stimulations took place in an acoustically silent chamber. The subject's eyes were covered with goggles and a motorcycle helmet with four equally spaced magnetic coils on each side was put on their heads. Each coil on one side was connected to the coil in the same position on the other side of the helmet, "yoking" them together.

Each subject (including those in the placebo group) was given the *hypnosis induction profile*, which included instructions to relax and imagine their left hand was floating on a balloon. During this standard procedure, the experimenter, who had been told the experiment was involved with hypnosis and relaxation, also touched the subject lightly on their left hand several times. When this imaginative exercise was finished, the experimenter told the subject to maintain the feeling it created. The door to the acoustic chamber was then closed. Each subject wore a lapel microphone that allowed them to speak to the experimenters in the event that they decided they wanted to stop.

During the next 20 minutes, each subject received stimulation with a complex magnetic signal using our standard parameters, which included four seconds with no stimulation (a "latency") after each repetition of the signal [an "amygdala burst firing" signal]. As with most of our studies using the God helmet, the signal appeared from each of the four magnetic coils on each side, one at a time, so that it rotated over the temporal lobes once every two seconds. The placebo condition was created by activating all of the equipment except for the final switch that connected the equipment

generating the signals with the helmet.

A magnetic sensor showed there were no discernible fields within the space filled with the subject's brain during the placebo stimulation. However, when the fields were active, the strengths ranged between 0.1 micro Tesla near the mid-point between the sides of the helmet and 1 micro Tesla inside the helmet, when the magnetic field was being produced by the magnetic coils on both sides. When the coils were active on only one side, the strength of the field on that side was about two or three times as strong as it was on the opposite side.

1. Dizzy or odd
2. Sensed presence
3. Tingling sensations
4. Visual images
5. Vibrations through body
6. Detachment or out-of-body
7. Anger
8. Sadness
9. Thoughts "not from own mind"
10. Ticking sounds
11. Odd smells
12. Fear or terror
13. Odd tastes
14. Felt as if somewhere else
15. Memories from childhood
16. Same thought kept repeating
17. Spinning or vortical experiences
18. Remembered a dream

The 18 questions asked after the Stimulation Session.

After the 20 minute stimulation (or placebo) session was over, the subjects were asked complete a questionnaire with eighteen items that asked about experiences commonly reported during our stimulation in our usual experimental context. We omitted two of the items from analysis because they weren't relevant to this experiment. Each item had three possible answers 1) never 2) once, or 3) several times. The score for each of the 18 items was divided by the average score for all of them in order to accommodate individual differences in both their internal

awareness, and their ability to report subjective imagery. It also provided baselines for the content of their experiences. We used a statistical method (*PA1*) to analyze the items, because of the possibility that a single experience or sensation might lead some subjects to answer more than one question.

Three months earlier, the subject had filled out questionnaires about their history of mild altered state experiences and spiritual beliefs. We referred to these to see the subject's previous experiences of the sensed presence and other *temporal lobe signs* (such as déjà vu, illusory feelings of movement, etc.). It also let us see if they were likely to answer yes to any question, and if they believed in the tenets of conservative religious faith (such as the second coming of Christ), or exotic ideas (such as believing that aliens are responsible for UFO reports). The statistical analysis was done on a computer, using standard statistics software.

Results

We analyzed the answers both for the 1) individual subjects, 2) compare male and female subjects for gendered responses, and 3) to see how the effects varied according to where the coils were applied. We saw a statistically significant difference between the averages for the scores for placebo, only the left side, only the right side, and both sides of the temporal lobes. [We found no gender-specific effects.]

The phenomena that varied the most according to the locations for the magnetic coils were: 1) the sense of a presence, 2) fear, and 3) odd smells. The biggest differences for the sensed presence and fear appeared according to where the coils were placed. The other items on the questionnaire given after the session did not show significant differences.

The groups who were given the stimulation over the right hemisphere or equally across both hemispheres reported the sense of a presence and fear more often than the groups who were given either the placebo procedure or the magnetic signal only over the left temporal lobe.

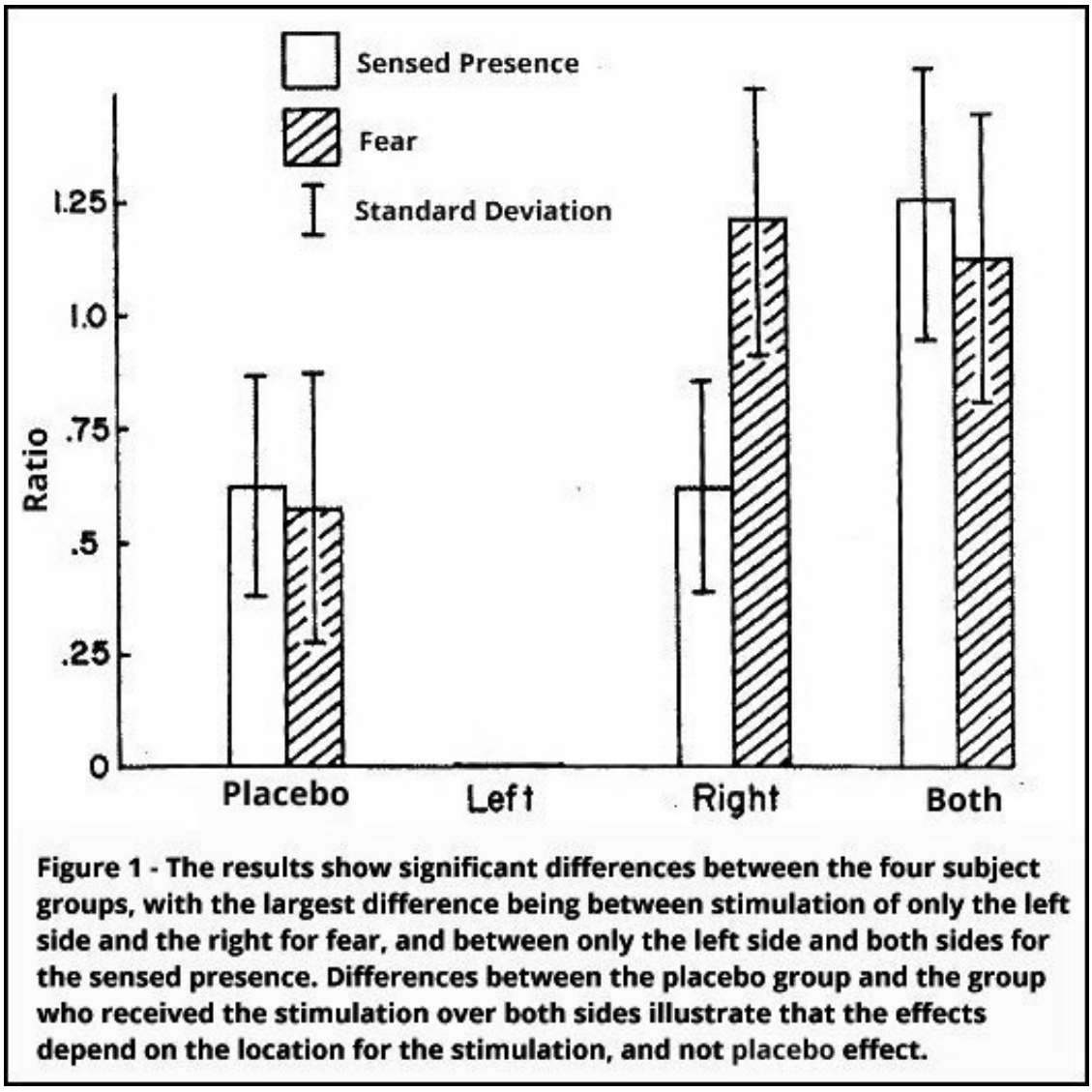


Figure 1 - The results show significant differences between the four subject groups, with the largest difference being between stimulation of only the left side and the right for fear, and between only the left side and both sides for the sensed presence. Differences between the placebo group and the group who received the stimulation over both sides illustrate that the effects depend on the location for the stimulation, and not placebo effect.

[The chart above shows a higher than usual response from the placebo group. This is a response to 1) *Spiegel's Hypnosis Induction*, which was done before the stimulation sessions. Hypnosis increases activity in the right temporal lobe, which is also the source of both fear and the sensed presence. 2) The sensory deprivation, which may have contributed to the sensed presence. Other studies, that didn't use the hypnosis induction technique, saw lower levels of sensed presence experiences in control subjects. Stimulation of only the left temporal lobes may be worth pursuing as a potential treatment for anxiety disorders]

The same stimulation of both temporal lobes shown above is one of two parts of the procedure that later appeared to be the most effective for eliciting

the sensed presence overall. The very low incidence for fear and the sensed presence with stimulation of only the left temporal lobe compared to the placebo implies that stimulation of only the left temporal lobe *suppresses* them.]

There were no statistically significant differences between gender, or any combinations of gender and specific locations for the stimulation. The biggest differences in fearfulness were between the group that received only right temporal lobe stimulation, and those received it only on the left temporal lobe. We also saw that the differences between the four groups for the sense presence remained, even after we removed the differences in their scores for fear.

[A mathematical discussion appears at this point, which is not incorporated into this rewritten version of the research paper.]

When we compared the results from the subject's questionnaires, taken three months earlier, we found there were no statistically significant correlations between their responses to the different locations for the stimulation and 1) their responses to the earlier questionnaire, or 2) their religious or spiritual beliefs. The only correlation we found was between response to the stimulation and reports of childhood memories.

Discussion

The results of this experiment support the idea that complex signals, embedded in weak magnetic fields, applied with a slightly higher intensity over the right hemisphere than the left, or with equal intensity over both sides, can make the experience of the sensed presence more likely. Two thirds of the subjects who received the stimulation over both temporal lobes reported the experience. [In later studies, the number is about 80%.] The results agree with, but do not prove by themselves, the idea that stimulation that makes the right hemisphere's functions intrude into the left hemisphere's ongoing operations, and forces the sense of self "based" in the left hemisphere to perceive its counterpart, "based" in the right hemisphere, directly. This neurological process manifests as the sense of a presence, being, or entity, which we don't [or can't] identify as being a portion of our own "self".

We've suggested that the sense of a presence, appearing when parts of the right hemispheric sense of self are imposed into its counterpart on the left side of the brain, could be the source of experiences where the person feels a "muse" or the "guiding spirit" which poets, musicians, and writers have spoken about for centuries. This perception is more likely in the early morning hours, especially between 2 and 5 AM, when the person would usually be asleep [keeping them on the outer fringes of a waking dream]. The arousal states that facilitate sustained creative bursts during these hours make an especially germane environment for the sensed presence, as the brain continues to secrete the sleep-related chemical, melatonin. The person is "primed" to dream, but can't because they're still awake, and this makes the right hemisphere more sensitive than usual. This unusual and persistent nocturnal activity in the right hemisphere allows the person to be unusually aware of any dreamlike feelings that appear. This includes the sense of a presence, which can be an especially powerful phenomenon in the middle of the night.

We can see the specific influences of our stimulation on either the right or both hemispheres in the number of sensed presences in the data from our subjects, both in the overall scores, and for how often it appeared. The frequency of the presence was analyzed to control for any unspecified effects that might have influenced the experiences covered in our exit questionnaire. Our results showed that stimulation of both temporal lobes had an effect on feelings of a presence, fear, odd smells, or anger. Two structures, the amygdala and the hippocampus (which are sufficiently inter-grown to be considered a formation in themselves), would be the most likely candidate for the source of this group of experiences. In fact, the same sensations have been evoked by direct, electrical stimulation of the limbic system in patients with epilepsy.

This group of experiences was enhanced in this experiment when the magnetic signal was applied over both sides or with a slightly higher field strength over the right side, and we suggest this means that the dorsal hippocampal commissure played an important role, as it connects the left and right hippocampus to each other. [The right hippocampus is a very "cognitive" (or "thinking") structure. It plays a crucial role in memory,

spatial perception, dream imagery and creativity.] If the pathways in patients with limbic epilepsy follow the same routes seen in normal brains, then stimulating the right hippocampus (and its neighboring structures) along with the amygdala could evoke neural activity that accesses the left hemisphere without going through the usual channels, either the surface of the right temporal lobe or the corpus callosum. These channels are essential for maintaining the normal sense of self. Bypassing them would allow the person to suddenly become aware of “messages” and “insights” coming directly from [the very dynamic and information-rich] hippocampal region on the right side. They would feel it wasn’t coming from their own minds and be, to employ a phrase we use frequently in our papers, “ego-alien.” [When information in the brain doesn’t use the pathways that support the “self”, it can feel like it comes from outside. Intrusive thoughts or even voices in one’s head can feel like they’ve been planted by an outside force, like an alien, an angel, or a demon. For a perception to feel like it’s “mine”, it must use the pathways that maintain “me”. If it doesn’t, then it can feel like it’s coming from outside of me.]

In such a case, the sensed presence, and the experiences that appear along with it, could manifest as an ephemeral feeling of having had an experience that we almost remember. It might seem more like a forgotten dream than an ordinary perception that utilized our normal sensory pathways. Our memories are created in and around the hippocampus, which is also the source of dream imagery and nonverbal reasoning. [A sensed presence experience would be able to make use of the pathways involved in either remembering or forgetting our dreams, making it easy for us to feel that the presence experience had a dreamlike quality to it.]

In earlier studies, we’ve seen that applying a signal that appears during memory formation (“long-term potentiation”) can affect the way we remember words. Applying this signal over the right hemisphere enhanced the intensity of subjective experiences, [and was also found to be more pleasant when applied over the right.] We’ve also seen that we could induce illusory memories of a story by applying a burst firing magnetic signal (derived from the amygdala) over the right hemisphere.

The amygdala and hippocampus play a significant role in the experiences

we attribute to our dreams, so it's worth noting that one of our exit questionnaire items, "I felt as if I 'remembered a dream", was not significantly affected by the signals. One way to interpret this result is that the hippocampus may have amplified the experience, making the subject's feel [perhaps temporarily] that it was real, and not like a dream, especially if we happened to evoke a presence while the subject was experiencing something worth remembering (during memory consolidation).

It's been suggested that a similar mechanism explains how visions of the recently deceased ("bereavement apparitions") frequently occur between 2 AM and 6 AM, on nights when the geomagnetic activity is enhanced. The right hemisphere is sensitive to geomagnetic activity, as we've seen in independent experimental and correlational data. Worldwide geomagnetic activity is typically about 100 times weaker, and has frequencies about 100 times lower, than the magnetic fields we used in this experiment. However, its subtle stimulations can act on the brain for hours, much longer than the 20 minute stimulations used in this experiment.

We don't have *direct* measurements for how our magnetic signals influence electrical activity in the deep (limbic) areas of the temporal lobes. [Gathering this kind of data would have involved implanting depth electrodes in the limbic system, a procedure that would be too intrusive for this kind of study.] However, we chose the design of the experiment because the responses we've seen to our various magnetic signals correlate with specific limbic-driven behaviors and experiences, and because they've been shown to entrain cortical brain activity (as seen on EEG).

For example, one of our experiments (carried out in the year 2000), induced a powerful sensed presence experience that appeared along with a specific (*paroxysmal*) EEG pattern from the right temporal lobe. In that case, we had applied a magnetic signal (not used in this study) designed to affect electrical seizures in the hippocampus and its immediate neighbors. More brain processes may be sensitive to signals carried by low intensity (microTesla) magnetic fields than has been realized up to now. For example, exposing rats to signals that encourage memory creation can actually interfere with creating some specific kinds of memory.

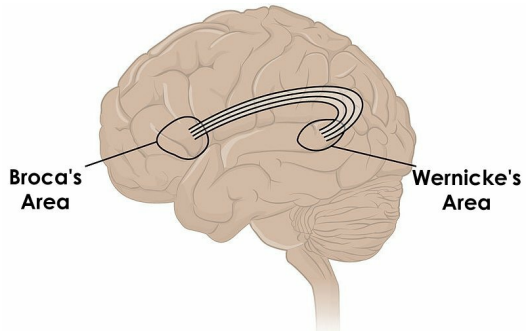
Although we didn't ask the subjects in this experiment about the nature of the presence, other studies showed us that about half of the people (always blindfolded) who said they felt that "someone else" was in the chamber with them, wondered how someone had managed to enter the room without them hearing them come in. In addition, about half of the subjects said that the presence moved when they tried to focus their attention on it. About one third of those subjects interpreted the presence as a deceased family member or some variation of a "spirit guide". They used various different words to describe the spirit, according to their cultural origins, including names like "alien" or "other dimensional beings". The presence always appeared close to the individual. Outside of our laboratory setting, it can appear in other situations that encourage right hemispheric states of consciousness, such as dreaming or very long drives ("White line fever").

We didn't study the position where the presence appeared in this experiment. However, in other studies, both unpublished and published [after this one], we asked our subjects about this, after both the magnetic signal stimulation and the exit questionnaire were complete. In these experiments, we found that stimulation of the right hemisphere elicited the sense of a presence mainly on the left side, while stimulation of both temporal lobes found the presence appearing on their right (35%), directly behind them (20%), or on the left (45%). In one recent experiment, 15 subjects were told to press buttons they held in each hand when they felt the presence. In that case, about 70% of their responses showed that they felt the presence along the left, when the fields were applied to the right temporal lobe. For the other remaining 30%, the sensed presence appeared about as often on their right side as it did just behind them.

In this study, none of the subjects who received stimulation over the left temporal lobe reported that they sensed a presence (see fig. 1). This suggests that stimulation of the left temporal lobe can *prevent* the right hemispheric "version" of the sense of the self from intruding into the left hemispheric "self". One explanation for this might lay in the way the left hemisphere responds to this specific magnetic signal. In 1999, we reported that we had stimulated each temporal lobe with the same signal used in this experiment (a burst firing pattern derived from the amygdala). Using EEG, we found that

the left, but not the right temporal lobe responded with increased alpha activity. This increased alpha response could interfere with the sensed presence. [Alternately, the decreased proneness to the sensed presence and the increase in alpha activity, using the same signal, applied to the same location, might both reflect a third, underlying and unknown process. We should remember that the dominant sense of self in our ordinary lives is the one on the left, with its ready access to our main language centers. The “self” on the right is subordinate in most moments, and stimulating the left side of the brain would tend to repress it (“crowd it out”) further, so that it wouldn’t be able to impose it’s metabolism, or electrical information, etc., onto the opposite side, a scenario that would make the sensed presence very unlikely.]

There is also experimental and clinical evidence that stimulation of the left hemisphere can *decrease* right hemispheric phenomena, like hypnosis. One of our studies found that we could hypnotize subjects more easily after the stimulation session if we applied this signal in two stages. First, to the left side, and then the right. The same effect didn’t appear when we stimulated the two temporal lobes in the opposite order. [We also found that stimulation across both temporal lobes elicited a wide range of spiritual phenomena, but only if we had first applied a different signal only to the right temporal lobe.]



The main language centers, on the left side of the brain.

We’ve worked with patients who sustained “impact” brain injuries (such as concussions), and experienced terrifying presences, most often between 2 and 4 AM, and found that listening to a tape-recorded message could stop these unpleasant episodes quickly. This simple treatment was based on the idea that the presence that seemed so frightening was a right hemispheric phenomenon, and that activating the language centers on the left side of the brain by playing a recording of a person speaking would increase activity

there, and bring their normal sense of self “back online”. We take note that the negative presence mostly appeared on the person’s left side.

More of the subjects in the placebo control group reported feeling the sense of a presence than in our previous studies. This may be due to the fact that the pre-stimulation hypnotic procedure may have encouraged some right hemispheric response, which in turn may have influenced the way the subjects responded to the exit questionnaire. [Other methods we regularly use, such as button-pressing in real time to register sensed presences, or correlating EEG response with the sensation, are not be subject to such confounds.] It’s very unlikely that expectations from the experimenters could have contributed to the results because neither the experimenter nor the subjects were aware of the purpose of the experiment or the hypothesis being tested. [They also didn’t know whether the subjects received the stimulation or the placebo until after their session was complete.]

One of our pilot studies included the subjects holding either their left or right hand and wrist in warm water for three minutes (as part of *Spiegel’s hypnosis induction* procedure) before we applied the burst-firing signal over the right hemisphere. Interestingly, more (85%) of the presences appeared on the left side of the subjects whose left hand had been immersed in the warm water before the stimulation. Fewer subjects (65%) whose right hands were kept in warm water reported feeling the presence on the left.

Tasks that stimulate the right hemisphere naturally, such as monotonous chanting, singing in a group, or having constantly changing images in the left or both visual fields (such as a campfire) can increase the chances for a spontaneous sensed presence experience, without any neural stimulation. We may wonder how to explain the small increase of the sensed presence experience in the placebo group in this study (above what we saw in our other experiments). It may be because the placebo subjects had their left hand stimulated (which would predictably increase activation of the right hemisphere) as part of the hypnosis done before the stimulation. Nevertheless, the results from the placebo group were not as strong as the effects reported by those who received any but the ‘left side only’ magnetic stimulation. This increase, due to the *Spiegel hypnosis induction* technique prior to the session, emphasizes how small stimuli can contribute to the

sensed presence in ordinary circumstances.

Deities, spiritual beings, or any other points of religious faith can be important components of people's beliefs about their own nature, whether they're alive or about to die. We have not tried to prove or disprove their absolute existence. The existence of goddesses and gods, outside of the brain are "null hypotheses" that can never be validated or falsified. Throughout human history, and across all human cultures, from the earliest hunting and gathering societies, these beings have been thought to be nonphysical, infinite, and existing in a way that can't be measured. Nevertheless, we've shown how phenomena that's traditionally been explained as the actions of the gods or a single God (such as visions or revelations), can be created by stimulating the brain with signals carried by weak magnetic fields. The processes triggered by these complex magnetic fields are very close to the ones at work in the brain during these paranormal states of consciousness, making it easy for them to integrate with each other without losing the information they carry.

There may be important scientific and practical applications for studying specific signals that interact with naturally occurring brain processes, including the ones that evoke the sense of a presence. People often attribute their subjective spiritual experiences to God or a higher intelligence, making it easy to have faith that a "higher power" agrees with their personal beliefs or the tenets of their religion. Religious beliefs can be reinforced by the sensation that one has been visited by a nonphysical being. These beliefs have been used to justify killing others on a mass scale, especially if they believe in a God with a different name, different attributes, or with a different set of ethical and moral rules. Understanding how the brain produces the sense of a presence, and knowing what kind of stimuli provoke it may help our species to avoid the kind of religious conflicts that have threatened our survival in the past, and this may help us survive in the future. [For example, many Americans who feel they have been "touched by God" and "felt lead" to evangelical Christianity are now convinced that we are now in the "end of days" prophesied in the Book of Revelations.

Many also believe that action to preserve our species and our planet in the face of intensifying climate change runs counter to "God's plan". Thus, many

evangelical Christians who have felt God's presence also regard efforts to preserve our planet's ecosystems as ultimately satanic. The same phenomenological experience (that of sensing a presence in the space around them and, in some cases, receiving private revelations from it), can be interpreted in other ways. If the neural basis of the God experience were more widely known, we might find that there were fewer people willing to vote for politicians who believe that the Biblical apocalypse is at hand, and that God plans for our species to undergo a global catastrophe.]

CHAPTER EIGHT

Evoking the “Sensed Presence" in normal subjects and an exceptional subject.

Cook, C. M., and M. A. Persinger. "Experimental Induction of The “Sensed Presence" in normal subjects and an exceptional subject’, *Perceptual and Motor Skills* 1997 Oct. 85: 683.

[Placebo controlled, single blind]

Editor’s note: [In this study, a placebo field was used to set a baseline condition. The subjects were told to press a button if they felt a presence, and this instruction precluded blind conditions. Several signals were used, and the subjects were not told which signals were expected to be most effective, or in what order they would be applied, creating a partially blind condition. It also tells how Sean Harribance (the “exceptional subject”), a medical intuitive, responded differently to two stimulation sessions differently than the typical research subjects did. The experiments re-confirmed that the signal derived from burst-firing in the amygdala was more effective for eliciting the sensed presence than others, as well as underscoring the differences between the various signals and their effects.]

Summary: Ten out of fifteen experimental subjects experienced the sense of a presence while they were given a series of three minute neural stimulations [the total session length was approximately 45 minutes] with four different signals, carried by low intensity (1 microTesla) magnetic fields or a placebo stimulation. They were told to press a button when they felt it. Their reports showed that trying to “focus” on its location appeared to make it move. We also tested an “exceptional subject” (Sean Harribance) who often experienced flashing images in his upper left visual field when he handled pictures of people. He told us that the images gave him information about the person’s health. Mr. Harribance attributed his psychic skills to a spiritual presence. He felt the presence more often when we applied our magnetic signals, without his knowledge. The results of these experiments support our hypothesis that the

> “sensed presence” is the right hemisphere’s “version” of the sense of self based in the other side of the brain. The left hemispheric “self” is the normal, “default” sense of self people identify as “me.” Directly perception of it’s counterpart on the right side of the brain may be the foundation for the experience of angels, spirits, gods, and other nonphysical entities reported from all cultures through history.

The feeling of a conscious presence, “sensed” as an incorporeal being in the world around us, is the most likely raw material or foundation for the experience of gods, spirits, aliens and other non-physical beings. Our hypothesis has been that the feeling of a presence or an immaterial being consists of a temporary awareness of the right hemisphere’s mirror image of our usual (left sided) “self”. The normal human “self” is largely an “artifact” [or ‘expression’] of our language processes, supported by the nearby speech centers on the surface of the left hemisphere. All human brains and human “selves” have approximately the same architecture, and so we’d be surprised if the sensed presence, arising from the brain’s left/right organization, were absent from any time in human history, or from any of our cultures.

We’ve offered the hypothesis that brief bursts of information that support the self on the right (and which usually stays in the right hemisphere) can intrude into the self on the left, and allow it to perceive its counterpart on the right side of the brain directly. The result is the sense of a presence. In other words, the “self” on the right side of the brain can force its way into the mind of the “self” on the left side, which it then experiences as an external being. [The alternative would be for the person undergoing the experience to feel that they are two people at once, and it appears that normal brains lack the necessary foundation for such a perception. This editor has encountered a few people, stories, and clinical reports, of people having “half” of an out-of-body experience, so that they are in their body and out of it at the same time. However, in the few cases where I was able to interview people who had the experience, I learned that they switched back and forth between the self that was in their body and the one that was out of it, and didn’t inhabit both of them simultaneously.]

[We can think of the two selves as the left and right channels of a stereo signal, and the sensed presence as “crosstalk” from the right channel to the left. The *signal* is intruding, not the voltage that carries it.]

There are times when the sensed presence is more likely. A few examples are: 1) during dream sleep, 2) stress that's powerful enough to induce very high cortisol levels, 3) any state that makes the right hemisphere hyperactive, and 4) any experiences or spiritual practices that encourages the two hemispheres to be more cohesive, such as Transcendental Meditation™. Temporary changes in the way pathways on one side of the brain connect to their counterparts on the other, can also encourage the sensed presence. This isn't uncommon in traumatic brain injuries, (when the *corpus callosum* (the structure that handles most of the communication between the brain's two hemispheres), or a lesser-known structure, the *dorsal hippocampal commissure* has been damaged by a "shearing force"). The *presence* is also more common for women than men, and more common for left-handed than right-handed people [presumably because they have more connections across the brain].

Some of our past experiments have shown us that applying magnetic signals across both temporal lobes make this extra connectivity (or *intercalation*) more likely. The one that matches "burst firing" in the amygdala has been the most effective for eliciting the sensed presence. Examining brain injury patients who 1) experienced mild to moderate head traumas and 2) who also experience the sensed presence often helped us see that it may rely on disrupted communication between the two sides of the brain. [Especially if the pathways that support signals or codes that maintain the self are damaged.]

This experiment was designed to see which of a series of magnetic signals (applied over the left, right, or both sides of the brain) would elicit the sense of a presence most effectively. Another goal was to compare the results from normal subjects to those from a "medical intuitive", Sean Harribance. We had already seen that applying several signals in sequence seems to facilitate resonance between the brain and the signal; nevertheless, until the mechanism is mathematically defined, we should consider this explanation as a metaphor. [Later papers eventually did provide a mathematical description.]

The study reported here actually consisted of three different experiments. The first was with a larger group of subjects, the second involved only the "exceptional individual", and the third used a group of four subjects.

The first experiment involved two signals that had only minor effects, as

well as two others (taken from the two most responsive structures in the limbic system) that had significant effects in previous experiments. The ineffective ones were simple sine waves, with very simple repeating structures and information. The most effective signals had irregular shapes and can't be reversed (side to side) or inverted (top to bottom) without changing the information embedded in them. [Your name isn't the same when it's written backwards, and it's harder to read if it's upside down. You might be able to read it, but it would still look wrong.] The most effective magnetic signals we've worked with were designed to bear information that matches and interacts with the brain's own electrical signals. One of our signals is associated with memory creation in the hippocampus, and we expected this signal to "rebound" and keep producing effects for a time after we stopped it.

In the second experiment reported in this paper, we gave the same series of magnetic signals to Sean Harribance, an "exceptional subject." We also did a second session with him, using a specific pattern (the "Thomas pulse", which we refer to as a "chirp" signal for consistency with the other edited papers in this book). We had seen the opiate receptors of snails respond to this signal. It had also elicited significant sensations of movement ("vestibular" responses) in people who didn't know that it was being applied. When these sensations happen without any stimulation, they tend to appear along with more frequent temporal lobe signs, including the sense of a presence, than we see in the normal population. Vestibular sensations are also associated with elevated geomagnetic activity, and reports of visions of the recently deceased. The third experiment (applying the "chirp" signal over the temporal lobes of four normal subjects.) was inspired by the results of the first two, and we performed it to see whether the "chirp" signal created phenomena for normal subjects as it did for Mr. Harribance.

Method

Subjects

The first experiment applied a series of different signals, one after the other, with a three minute break between them. It involved six male and nine female volunteer subjects between 21 and 23 years old. They were students in a first year psychology class who had been given a 2% bonus mark for participating in the experiment. The second experiment was confined to a

single “exceptional subject,” a 56-year-old man (Sean Harribance, who had been earning his living as a psychic for several years). He had reported a long history of finding hidden objects and perceiving the medical and health histories by examining or just holding their recent photos. These “psychic readings” came to him as “brief flashes”, appearing in his upper left peripheral vision. He felt these fleeting visions, and their accuracy, were given by a few spiritual beings, including a “guiding spirit”. The third experiment involved seven volunteer subjects (four females and three males), from 20 to 21 years old. They were given a 1% bonus credit towards the final grade in a psychology class.

Procedure

The subjects were asked to remain quiet as they sat, blindfolded, in a large comfortable chair placed in a completely (“acoustically”) silent chamber [Also a vibration-proof] Faraday cage]. The subjects were told to press a button when they felt a presence. We provided two buttons, one on each side. They were told to press the button on the right when they felt a presence on the right side, and one on their left when they felt a presence on the left, and both buttons if they felt a presence behind them. We used a strip chart recorder to make a log of exactly when they pressed the button, allowing us to verify which magnetic signal, if any, was being applied at the time.

Each subject wore a snowmobile helmet with four pairs of magnetic coils attached to it. Each pair of magnetic coils consisted of one coil on each side of the helmet. These coils produced the magnetic signals. They were attached to a computer-controlled device, which produced the fluctuating electrical current that “shaped” the irregular magnetic signal.

For the first experiment, subjects were given stimulation in this sequence:

No signal. (Baseline, or control condition)
A 3.3 Hz sine wave.
No signal.
A signal derived from memory formation.

No signal.
A 1.6 Hz sine wave.
No signal.
The burst firing signal.

The intervals without any signal lasted three minutes each, while the actual stimulations lasted 2.5 minutes each.

Of the 15 subjects in the first experiment, 10 reported sensing a presence [or 9, as one subject stopped participating, as described below], which we saw through their button presses. We applied the signal over both hemispheres (four subjects) the right hemisphere (three subjects) and over the left hemisphere (three subjects). We analyzed the numbers of button presses in 20 second intervals. [Unfortunately the paper doesn't say which of the three positions for the coils had the *fewest* sensed presence reports. However, other experiments saw a sharply reduced number of these reports with stimulation of only the left temporal lobe, which may account for approximately 20% of the difference between this and other similar experiments.]

In the first part of the second experiment, the "exceptional subject" was given the same procedure, using the same sequence of magnetic signals the other subjects received, applying them over both hemispheres (above the temporal lobes). The magnetic signals were applied using coils held by plastic containers, using Velcro strips to hold them on his head. Mr. Harribance was also told to press the buttons when he felt a presence, the same as the other subjects.

For the second phase of our second experiment with Mr. Harribance, he was given only the chirp signal for 25 minutes. The session applied the same signal throughout, but used five different gaps between each run of the signal, which lasts about 9/10 of a second. We calculated the number of times he pressed the buttons in one minute, recording the *presence* each time he felt it (on the left, right, or behind him) both when the signal was applied, and when it wasn't.

In the past, we had seen strong results from the chirp signal in evoking phenomena and sensations which are likely to appear at the same time as the *presence*, such as sensations of movement and apprehension. This led us to

predict that normal subjects would also feel a *presence* more often when they were stimulated with it. If this were so, the size of the effect would be larger, and we wouldn't need many subjects to show a statistically significant effect. Four of the seven subjects (two male, and two female) experienced a strong and repeated senses of a presence. We analyzed their data to see the number of responses when the chirp signal was being applied, and when it wasn't. Each 20 second time frame was treated as one EEG "case", and the four periods (each three minutes long) were calculated as "dummy" (or placebo) stimulations. We used standard statistical analysis software for the calculations.

The total time for each subject was between 45 and 50 minutes. All the testing was done in the evening between 6 PM and 10 PM. We also checked the geomagnetic activity, which remained quiet or very quiet during the experiment. We felt this was important because people in our acoustic chamber had reported vestibular phenomena (related to balance and sensations of movement) during more turbulent geomagnetic conditions.

Results

Quantitative analyses

First experiment

Our analysis for all 10 subjects who reported sensing a presence frequently found a significant relationship between which specific magnetic signals were applied and the number of times the subjects felt the presence. The four subjects who received the signal (derived from the memory creation process - the "memory signal") over both sides showed conspicuous increases in the number of presences they felt during the first two minutes *after* we had turned the memory signal off. The smallest number of them happened while the "memory signal" was being applied. The burst firing signal elicited button presses most often during the stimulation, eliciting the *presence* about five times more often than the "memory" signal. [Note that if the effects were due to suggestibility, experimenter expectation, or placebo effect, these numbers would have been the same.]

We also divided the number of button presses during both the burst firing signal and the "memory" (long-term potentiation) signal by the number of button presses during the silent intervals that came after them. The difference

between feeling the sense of a presence during stimulation and immediately after showed a statistically significant effect, with the memory creation signal being about one third as effective as the burst firing signal for eliciting the presence during stimulation.

For Mr. Harribance, the results were obvious. In his case, the “memory” signal was 37.5% more effective than it was for the other subjects.

Sean Harribance had different responses than the student subjects; he pressed the button between five and ten times per minute when he received the placebo field. During the stimulation, he pressed the button between seven and fifteen times per minute, depending on which signal was used, and where it was applied.

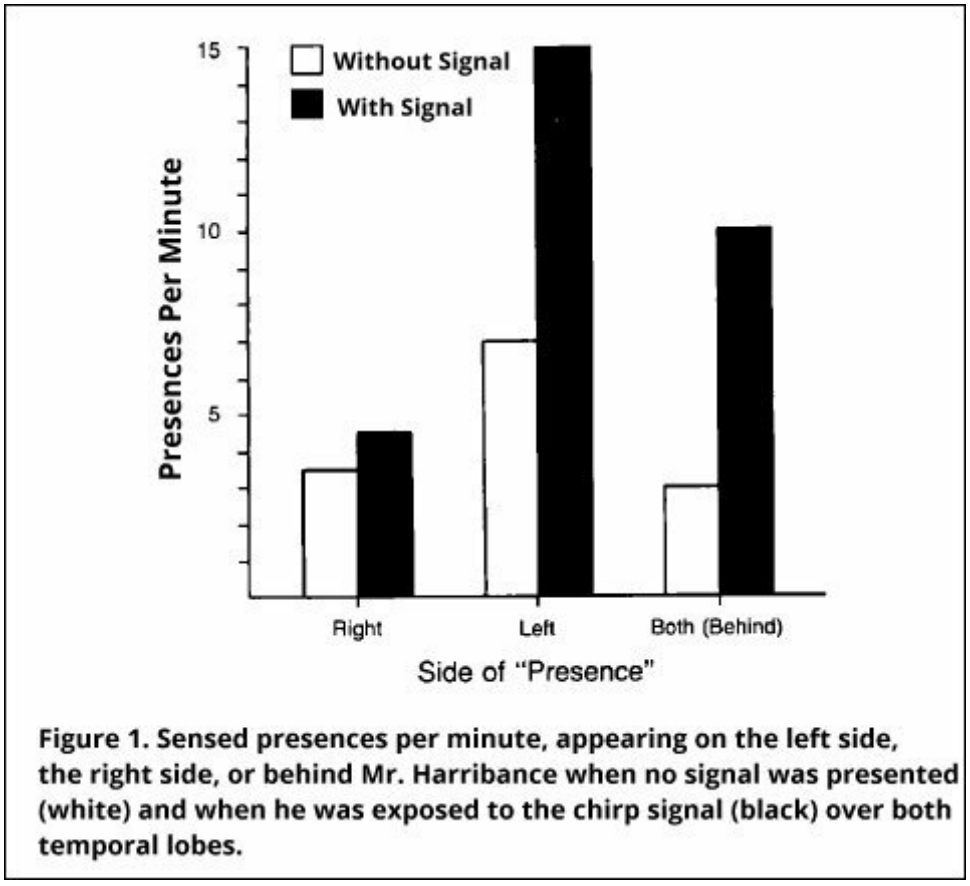


Figure 1. Sensed presences per minute, appearing on the left side, the right side, or behind Mr. Harribance when no signal was presented (white) and when he was exposed to the chirp signal (black) over both temporal lobes.

Mr. Harribance also experienced the sensed presence behind him during the stimulation more often than the subjects in the other experiments, and (as shown in figure 1), compared to the placebo condition.

Experiment number three, which involved only four subjects, also had

clear results. The average number of presences per minute was 29% higher than during the intervals with no stimulation. Statistical analysis confirmed that the chirp signal was responsible for the number of sensed presence experiences.

Subjective experiences and phenomenology

It may be helpful to see some of the reports of the subjective experiences. One woman, given stimulation with the sequence of signals used in experiment 1, (applied over the right temporal lobe) reported several individual episodes where she felt the presence behind her and on her left side. She reported that she felt a "feeling of rising" or detachment from herself. She felt as though she was floating, and that a thread (or something like it) prevented her from rising upwards. After the session was over, she experienced a sense of "overwhelming weirdness". However, she also asked to repeat the procedure [which implies that it wasn't a negative experience].

Another woman who participated in experiment 1 said that she felt a presence behind her and on her left. She had also been given the stimulation over the right temporal lobe. The presence moved when she tried to focus on where it was. She said that there were moments when she felt that, if she had her eyes open, it would be directly in front of her face. She felt a significant apprehension, and decided to ignore the presence and not to press the buttons any further. The most common theme in the descriptions we heard of the chirp signal was negative vibrations moving through the body. [Note that the chirp signal, applied to the right temporal lobe, is just *one* of the components of the stimulation that led to visions of God for a small number of subjects. In that session design, it's followed immediately by stimulation with the burst firing signal over both temporal lobes, which often results in religious and mystic experiences including, in some cases, extreme positive emotions, like bliss or ecstasy.]

Discussion

The results we obtained from our normal subjects agree with our previous experiments that the sensed presence can be induced experimentally, when low intensity magnetic signals (which our theories tell us increase the amount of right hemispheric information that can be imposed on the left hemisphere) are fed through and across the temporal lobes. One specific signal, (derived

from burst firing in the amygdala) elicited more sensed presence moments than the other, [except for Mr. Harribance]. We've used this signal in other experiments, where we saw it raise pain thresholds in rats bred to have more sensitive limbic systems than normal rats. We have also seen it elicit "pleasant feelings" in human subjects. We originally derived this signal from amygdala neurons in the brain of a temporal lobe epileptic, [and later confirmed that it also appears in normal brains].

This experiment showed us that this signal, which evokes memory creation (as seen in slices of tissue from the hippocampus), and enhances retention, may also contribute to the sensed presence experience. However, for Mr. Harribance, the presence appeared more often with this signal after we shut it off than it did when it was actively applied. [The same effect didn't appear with the burst firing signal.]

Although the mechanism isn't clear, we suspect that some signals may immediately increase the coherence [or integration] of the left and right portion of the pathways for the sense of self, and evoke the sense of a presence. In contrast, the memory signal appears to contribute to this integration by *inhibiting* communication between the two "selves". When it's then removed, the structure it targets (the hippocampus) rebounds back into activity, amplifying the integration of the left and right "selves", and elicits the *presence*. Deeper, (limbic), brain structures can also be excited by "hyperactivity" in the surface of the temporal lobes. This tends to agree with some of our other studies, which found that the sense of a presence is common in temporal lobe epileptics and people with more temporal lobe signs (such as déjà vu, tingly sensations, feelings of strangeness or the feeling that one's body is moving when it's actually keeping still).

It doesn't always take high levels of energy in the right hemisphere to create the pattern of brain activity the sensed presence depends on. [Increased communication between the left and right hemispheric "selves" often means more information, not more voltage.] The experience can happen following low energy events (if they have the right information "encoded" into them). This explains why positron emission tomography and MRI don't show the brain activity that supports the sensed presence. They can show the amount of activity, but not any of the information the activity carries. [It would be like having a Wi-Fi detector that shows you how strong a signal is, but not what it's carrying.]

The fact that the subjects were able to “move” the presence by focusing on its location shows that “thought” and “intention” can change the brain activity it depends on (or correlates with). It appears that the “presence” can respond to, or interact with, a person’s thoughts and intentions. Through most of human history, and in all of our cultures, people have thought that the feeling of a presence meant that there was an actual nonphysical being nearby them [This may be the basis for faith in prayer, though we should remember that not all prayers are directed to deities. People who’ve lost a loved one often try to communicate mentally or telepathically with their departed spirit, a spiritual practice that seems indistinguishable from prayer.] Nearly all nonphysical beings that appear in the world’s religions or folklore are believed to be able to communicate with people, and vice versa.

The idea that the sensed presence originates the right hemisphere of the brain has a long history. More than a century ago, Frederick Myers suggested that there might be a “subliminal self”, not unlike the idea of a “hidden observer” [or “watcher”] within human consciousness. He used the idea to explain phenomena [not specified in this paper] that appeared during hypnosis, and believed they were primarily right hemispheric experiences. Myers worked with the premise that his subjects (spirit mediums) were engaged in a valid practice (they weren’t “faking”), and that this subliminal self, which came into play during paranormal and spiritual states, was able to access spiritual and paranormal phenomena.

Paranormal phenomena have a propensity to appear on the left side of a spirit medium’s body, and Myers believed this supported the idea that spiritual and paranormal experiences (like hearing spirits rapping or seeing apparitions) have their source in the right hemisphere of the brain. These interesting and astute observations seem to have been forgotten or ignored. Our technology and methods may allow us to refute or confirm these fascinating 19th century ideas, either partly or completely.

The experiment, with our “exceptional subject”, implies that the presence we trigger when applying our magnetic signals could be similar to his guiding spirit, which helps him in his psychic work. He felt its presence primarily while receiving the “memory” signal. The normal subjects in the first experiment were more likely to experience a presence after that signal had been ***stopped***. It may show that Harribance’s brain had significant differences in the way it was organized at the microstructural level [such as a

larger number of excitatory synapses or neurons connecting the right hippocampal region to the amygdala on the left side]. We can speculate that he experienced the presence immediately on receiving the memory signal instead of afterwards because he had fewer of the inhibitory synapses that usually filter out the large amounts of information from our senses. Harribance mentioned being “inundated by visual images like rapid films clips”, which would be consistent with this idea. The fact that his high-speed, brief images appeared in his upper left visual field suggests that there could be an electrical focus [or an unusually sensitive area] in the right occipital-temporal area, or that optical pathways in the temporal lobe (Myer’s loop) are involved.

Interestingly, Harribance’s neural and psychological profile implied there was a long-term compromise of spatial memory and his ability to orient himself in space. He also showed signs of mild deficits in the left occipital-temporal area. The simplest explanation would be that he had unusually strong connections between the hippocampal region on the right and the left temporal lobe. This disinhibition allowed information from the right hemisphere to find its way into the language areas on the left side of the brain through pathways that do not support the normal sense of self (most importantly, through the dorsal hippocampal commissure). This might emerge as the experience of a being coming from outside of himself and participating in (or contributing to) his thoughts. Long-term reduced function in the right parietal lobe of his brain, along with moments of very low activity when he had his fleeting visions, might explain the information he received, reflecting activity (or contributions from) in the right hippocampus, with its sensitivity to our “memory signal”.

Sean Harribance also had a stronger response to the chirp signal than we saw in the normal subjects. We knew it could create unpleasant dizziness and even vertigo when applied to the right temporal lobe. Harribance reported that most of the presences appeared on his left side, and he felt “unpleasantness” and fear when the chirp signal was applied on his right temporal lobe. It reflects the associations between activity in the right hemisphere; dizziness, “visitor experiences” and panic attacks [also seen in epilepsy], and the fact that some low intensity magnetic signals can elicit these experiences, when they’re applied to the right temporal lobe over the right temporal lobe.

We were also able to elicit the sensed presence frequently in normal subjects using the chirp signal (experiment 3). This implies that it can be a more effective signal in some contexts. However, the burst firing signal, which we've seen elicit mostly pleasant experiences (unless it's applied towards the back of the head, on the right side, in right-handed women) actually produces the sense of a presence more effectively and avoids possible unpleasant effects of the chirp signal. The reports of unpleasant vibrations through the body are unique, appearing only with this signal. Subjects receiving it while undergoing stress have reported shivering, cold, visions of a "bright white light", and a sense of impending death.

[In contrast, this same signal, when applied only over the left temporal lobe, has elicited extreme positive emotions, including elation and bliss. However, according to a conversation this editor had with Dr. Persinger in 1997, this unpublished effect was unlikely to occur a second time.]

CHAPTER NINE

Experimental simulation of a haunt experience and elicitation of paroxysmal electroencephalographic activity by transcerebral complex magnetic fields: induction of a synthetic “ghost”?

Persinger, Michael A., S. G. Tiller, and S. A. Koren. "Experimental simulation of a haunt experience and elicitation of paroxysmal electroencephalographic activity by transcerebral complex magnetic fields: induction of a synthetic “ghost”?." *Perceptual and Motor Skills* 90, no. 2 (2000): 659-674.

Editor’s Note: a few very technical sections of the original paper have been removed from this case history.

Summary – To test the idea that we could simulate the experience of a frightening apparition in the laboratory, we applied magnetic fields (with complex patterns embedded in them) across the temporal lobes of a 45-year-old journalist and musician who had a frightening ghost experience four years previously. Within 10 minutes after we began to apply a “chirp” signal over the right temporal lobe, the subject reported “rushes of fear” that culminated in the experience of an apparition. We also monitored his neural activity through EEG. At the same time as the subject experienced fear, his EEG showed conspicuous paroxysmal “spiking,” a pattern similar to those seen during epileptic seizures. Each of these waves of fear lasted between one and two seconds. A second, separate stimulation with a different signal (derived from burst firing in the amygdala) was applied over both temporal lobes, and this second signal was associated with pleasant experiences. The subject told us that the synthetic “ghost” was very similar to the one he experienced in a natural setting (a “haunted house”). We learned that it’s possible to simulate these experiences in a controlled setting, and that the experimental technique we used may help us to understand what evokes them in nature.

One way to simulate the experiences usually attributed to “haunts” or “ghosts” is to apply complex magnetic fields to the temporal lobes of individuals who’ve experienced them before. These complex signals can create the conditions in the brain that we suspect happen naturally when people have experiences of nonphysical beings. This case study was designed to see if a normal person who’d previously had a ghostly experience would feel that the phenomena we created through our stimulation was similar to his initial, actual experience in a “haunted house”.

In some of our previous work, we found that applying a frequency

modulated (“chirp”) signal through a magnetic field over the *right* side of the brain for 20 minutes made it more likely that normal people would report feeling the sense of a presence (or the feeling of “being watched”) as well as negative emotions, especially fear. In most of these cases, the “presence” was experienced as being on the left side of their bodies. In contrast, when subjects received stimulation with a different (“burst firing”) pattern once every three or four seconds over *both* sides of the brain for 20 minutes, they reported positive thoughts and emotions. These were evident in the “pleasantness” of the words they used to describe the experience. Usually, the sense of a presence is pleasant, [and in some cases even blissful,] when it appears on a person’s right side. Interestingly, the same burst firing signal has also reduced sensitivity to pain in rats when they are exposed for the same length of time.

Method

Subject and History

The subject in this case study was a 45-year-old professional journalist and musician who’d been living in Canmore, Alberta at the foot of the Rocky Mountains. In 1993 he, his wife, and their two children moved into a house that had seen several tenants during the previous years. Within days of moving in, the members of the family began to have episodes of anxiety, depression, and a general feeling of discomfort (*malaise*). At times, they heard sounds like someone knocking. Light bulbs went dim or became brighter without any apparent cause. They also said their computers and electronic devices behaved “strangely.” Everyone in the house sensed a presence or felt that they were being watched. They also had nightmares.

The rooms in the house seemed to be damp most of the time, and they often noticed spiders. The subject and one of his friends (a male), a local politician, decided to explore the crawlspace between the floor of the house and the ground, trying to find out why there were so many chilly drafts and spots that seemed colder than the rest of the house. Both of them felt intense fear and cold while they were in the crawlspace. The subject also reported that small lights sometimes formed an oval under a light fixture. Both of them felt a presence. This form disappeared soon after the men talked about

what they had seen, and the subject's visitor whistled. The subject eventually sold the house and left town.

Procedure

The subject had heard about our work in Laurentian University's Neuroscience Research lab, and asked for an opportunity to experience the magnetic signal neural stimulation we use in our work. On the day of the experiment, he filled out one of our questionnaires (normally given to subjects weeks or months before they participate in one of our experiments, but this was a case study, not a formal experiment.) that asks about personal philosophies and religious beliefs. Thus, we were able to measure 1) how sensitive his temporal lobes were, 2) how truthful he was, 3) any tendency to just say yes to questions he wasn't sure about, 4) how many paranormal experiences he'd undergone, and 5) whether or not he had a history of epilepsy (which would have excluded him from participating).

After that, he sat in a comfortable arm chair in an acoustic chamber, which was also a Faraday cage (filtering out electronic noise). He wore a blindfold made from a pair of swimming goggles that held a cloth in place, closely over his eyes. We also attached EEG sensors at the front and middle of each temporal lobe and towards the back of the head, on each side of the occipital lobes. We put the God Helmet on his head, consisting of four magnetic coils on each side, directly above the temporal lobes. His comments were recorded using a tape recorder, with a microphone attached to his lapel. We told him that he might or might not be exposed to magnetic fields, and that we would stop the experiment immediately if he asked us to. We didn't discuss details of the stimulation or what kind of signal would be embedded in the magnetic fields. We kept our sensory deprivation chamber dark except for a single small red light; the kind sometimes used in photography dark rooms.

During the first 20 minutes, a frequency modulated signal (the "chirp" signal) was applied over the right temporal lobe. We set the switches so that the field strength would be five times stronger over the right side of the brain than the left. [Usually, the difference is about 10%.] During the second 20 minutes of the stimulation session, we applied the burst firing pattern, which

created the positive phenomena we saw in our previous work.

Results

The subject's scores for the questionnaire [*The Personal Philosophy Inventory*] were about average. In fact, he was less likely to say yes to ambiguous questions than most people.

The subject described his experiences frequently while receiving the magnetic signal stimulation. In fact, he made some kind of comment about every 10 to 20 seconds while he received the chirp signal in the first phase.

Here is a list of his comments from the first phase of the stimulation session:

1. Shadows coming from the right side, moving around.
2. Tingling, drooling along the right side.
3. Tingling right leg.
4. Someone is touching me along the left side.
5. Left side tingling; inside of thigh; almost sexual.
6. Feel tense; something between shoulders to the left.
7. Tightness in chest.
8. A rush.
9. Dry throat.
10. Tingling inside of thigh.
11. This is not pleasant.
12. Foreboding feeling.
13. Feel my toes twisting.
14. There's a flash of light.
15. Subtle visual effects – shadows.
16. Shadows
17. Drooling.
18. Tingling from hands; need to scratch.
19. Breathing.
20. I see visuals.
21. (Vision of) architecture (Gothic) in depth.
22. I'm shaking (first EEG paroxysmal

activity occurs).

23. Shivers.
24. Visuals coming from the left side, slight tunnel.
25. Feel elevated.
26. Wants to lean forward.
27. Hints of color like the aurora borealis.
28. Tension in left shoulder.
29. Drooling from right.
30. Tunneling experience.
31. Tunnel from right side - it shrinks and expands.
32. Left side feels strange under my jaw.
33. Clinching feeling.
34. Left arm spasm.
35. Involuntary movement.
36. Feel like I'm being controlled.
37. I'm easily distracted.
38. Body twitching.
39. Rush … I'm suddenly cold.
40. A visual.
41. Visual - I see an apparition … That's it.
42. Hands sweaty.
43. Seeing visual dots.
44. Don't stop.
45. It's going now.

For the first 12 minutes of stimulation (using the chirp signal over the right side of the head), the EEG activity was dominated by the Beta band over the frontal lobes and a mixture of the alpha and beta range activity towards the middle and back of the head. In the remaining eight minutes, the subject's EEG showed us that he had a total of 16 instances of activity not unlike the kind that appear in seizures (*paroxysmal* activity), from the right temporal lobe. These brief episodes lasted between half a second and 2 ½ seconds. They did not appear rhythmically. The shortest time between these EEG events was two seconds, and the longest interval was slightly over four

minutes. Six of these events happened while the subject was actually feeling a presence in the room with him, coming from 2 to 4 seconds apart. The subject reported strong “rushes” of fear, cold, and shivers when the events lasted two seconds or more. He asked us to continue the stimulation, even though there was fear and distress in his voice.

During the second phase of the stimulation session, applying our burst firing pattern over both temporal lobs, the themes of his experiences changed from unpleasant to euphoric. In the first four minutes, the seizure-like EEG patterns appeared six times. There weren’t any unusual EEG patterns in the remaining 16 minutes. All of the six sensors showed his brain activity dominated by fast, high amplitude beta activity that hadn’t appeared before that. In fact, the EEG pattern was very similar to what we had seen in some people doing transcendental meditation.

Here is a list of his comments during the second phase of the session. [Notice that the sensations he reports become more pleasant as they go along.]

1. (I’m seeing a) circular object like an upside down China plate the color of soapstone hovering over the left upper visual field, (and) moving in and out of (my) vision.
2. (My) Head wants to fall to the right.
3. Visual.
4. Twitching.
5. Hard to collect (my) thoughts.
6. Feeling manipulated.
7. An urge to Burp (an actual burp followed).
8. I feel I have no control of my head.
9. Feels like I have Parkinson’s- shaking.
10. Head feels like it’s sitting strangely on my shoulders.
11. Head feels like it’s on my right shoulder.
12. Funny thoughts.
13. Feel(ing) pleasant.
14. Burning in stomach.
15. Twitching.

16. Hands clammy.
17. Starting to relax.
18. Pressure on right side of head.
19. Tingling feet.
20. Right side of chest twitched.
21. There’s a song in my head.
22. Things coming from the right.
23. Unpleasant taste.
24. Blue phosphenes.
25. Blue phosphenes.
26. Sinus pressure.
27. Warm feeling along the left side.
28. Detached.
29. Drooling.
30. Depressed.
31. Feeling weepy.
32. Burning sensation.
33. Depression. Malaise.
34. Wants to speak in phrases.
35. Feel like smiling.
36. Want to burst into laughter.
37. I see female genitals.
38. Overall pleasant feeling.
39. Hearing music.
40. I hear music.
41. There are lights on the right side.
42. Lights to the center right.
43. See a pair of eyes approaching, looking at me.
44. It’s taking definite form.

[This experiment differed from our usual protocol in that the first phase used magnetic fields five times stronger than those used in the second phase. Usually, the difference is about 10%. That meant that the second phase was less euphoric than we often see. The first phase, predictably unpleasant, would have created higher-than-usual barriers preventing deeply blissful

experiences from appearing.]

When we looked closely at the EEG records, we saw that 68% of the seizure-like activity happened in the last half second of the chirp signal. The equivalent frequency of these brief episodes was about 6 Hz. Only one of them happened during the first 1.5 second of the first phase. [Before the effects of the first phase had time to taper off.]

The subject's responses to our basic post-stimulation questionnaire [which we augment with free-flowing interviews that allow the subject to express their impression freely] are below. [The total scale is from -2 to +2. Higher numbers mean more pleasant and happening more often]:

Item	Chirp Signal (Phase One)	Burst Firing Signal (Phase Two)
I felt dizzy or odd	2	1
I felt a presence	1	0
I felt tingling sensations	2	2
I saw vivid images	1	1
I felt pleasant vibrations through my body	1	1
I felt detached from my body	0	1
I heard an inner voice calling my name	0	0
I experienced anger	1	0
I experienced sadness	1	2
The experiences were not mine	0	0
I heard a ticking sound	0	0
I had odd smells	1	0
I experienced terror	1	0
I felt as if I were somewhere else	2	1
I experienced childhood thoughts	0	0
I had a recurring idea in my mind	1	2
		(Music)
I saw images from a recent dream	1	1
I felt sexual arousal	1	1
General Rating:		

The subject reported that the apparition he experienced during the first phase of the session was extremely similar to what he had encountered in his haunted house, four years earlier. The central themes of his experiences during the second phase were similar to what he experienced while playing music [and presumably, “getting into the groove.”]

Discussion

Several experiments have showed us that these signals, embedded in low intensity magnetic fields, can affect the themes of emotional experiences and memory, and that they can be shown on an EEG. More intense magnetic fields, with simpler signals than we use have also evoked changes visible through EEG. Our experiments have been inspired and guided by the idea that all experiences are electromagnetic patterns within the brain. These patterns, and the experiences that go with them, can be changed by the right application of low intensity magnetic signals that interact with the electrical activity, and its signals, happening in the brain.

The results of this case study suggest that this technology might be used to understand the neural basis for experiences that have been attributed to “haunts” or “ghosts” and to isolate the kind of stimulation that evokes these phenomena in the real world. Modern science has not paid much attention to these experiences, in spite of the fact that they’ve been reported from every culture throughout human history. We can see that it’s possible that we can stimulate these experiences in the laboratory, and that offers us an alternative explanation as of their source, as well as a way to identify their causes.

The subject reported a strong similarity between the experiences in our laboratory and what he felt in his original ghost episode. However, it could be argued that the subject’s memory of his “haunt” experience might have influenced the way he reported his session in our lab. It became clear that the neural source of his experiences was in the right temporal lobe, and imaginative individuals have long periods of higher metabolic activity in several areas of the right hemisphere. Further, because retrieving long-term memories involves activity in the right frontal lobe, the combination of the

subject's expectations and the overall excitement of the right hemisphere through our magnetic signals may have made the memory of his haunted house episode somewhat more vivid.

Several results suggest that the intense and fearful experiences during the experiment did not come from the subject's personality or random responses to the magnetic signals. First, he reported unpleasant emotional themes while the chirp signal was applied over the right hemisphere, and his pleasant remarks came when the burst firing pattern was applied over both sides of his head. This agrees with the results of other studies (using approximately the same stimulation) with participants who had no history of ghostly experiences. Second, our subject had average scores for questionnaire items that indicate temporal lobe sensitivity. He had very few paranormal experiences, and he didn't hold "exotic" ideas [like new-age or mythological beliefs]. His scores for these items showed that he was not particularly prone to experience these phenomena spontaneously, and this is consistent with the hypothesis that, given enough of the right kind of complex magnetic signal stimulation, anyone will eventually respond to these fields. Third, while the experiences were becoming more intense during the first phase (that used the chirp signal over the right temporal lobe), the subject felt that the presences were appearing on the left side of his body. This kind of "sidedness" is consistent with the principle in neuroscience that, for some functions, the left side of the brain controls the right side of the body and vice versa.

The most compelling part of this study, though not as easy for laymen to understand, is that we saw clear and repeated paroxysmal ("seizure-like") activity, centered in the temporal lobes. The subject had no way of knowing it, but they appeared when he was experiencing "rushes" of fear or cold, and this tells us that our complex signals evoked brain activity that was associated with *both* the subjective experience and the unusual EEG traces. We should note that the frequencies and shapes of these EEG patterns do not reflect *actual* epileptic seizures.

Because the subject didn't have a history of epilepsy, but still displayed a similar pattern on EEG while we were applying the chirp signal over the right temporal lobe, these striking "brain wave" signatures couldn't have appeared spontaneously, and weren't the result of errors in interpreting them.

There is almost no chance that these EEG signatures came directly from the fields we applied. The signals move as they are applied, with the magnetic fields cycling counterclockwise through the four coils. Each of the magnetic coils is only active for less than a second. Meanwhile, the paroxysmal activity lasted two seconds or more. These discharges did not occur continuously, even though the stimulation did. Moreover, the same EEG signatures continued for the first couple of minutes of the second phase, when a different signal was applied, this time to both sides of the head. [To put it simply, our signals influenced certain brain parts, and they, in turn, responded with the *paroxysmal* activity.]

We completed the study more than two years before this publication. Since then, the subject has traveled extensively and followed work schedules that disrupted his daily rhythms and deprived him of sleep. Schedules like that often encourage seizures. So does his practice of seeking out deep mines, where he could experience total silence and darkness. Nevertheless, he has not experienced any of the phenomena he reported during stimulation with our magnetic signals since his session in our lab.

We've tested many non-epileptic subjects [later, the number came to over 2000] using this specific session design. Although reports of sensed presences and other mystical experiences (including apparitions) have frequently happened for us, the subject's reports [and EEG data] reflected one of the most intense responses to our stimulation we've encountered.

We suggest that repeated exposure to environments reputed to be haunted could sensitize a few thousand neurons within brain structures along the pathways that connect the limbic system, the thalamus, and the temporal lobes. Being exposed to man-made electrical and magnetic fields [as well as unusual geomagnetic activity], similar to those found in haunted locations, could either induce paranormal experiences, or revive memories of such an experience. Paranormal locations would stimulate neurons that had previously been sensitized in the brains of people with a history of paranormal episodes [whether they come from time spent in a haunted location or from lifetime sensitivity to such experiences].

We still have yet to measure the conditions in nature that facilitate

paranormal experiences directly. We suggest that tectonic strain from the earth itself (the kind that's discharged by earthquakes and tremors) may be one of the primary sources. Although simple pulsations of the earth's magnetic field may contain signals that can induce electrical activity in the brain, more complex signals could potentially contain information that's also at work there, and which may be present in areas undergoing geological strain. If this is correct, then in extreme cases, the earth's magnetic field could stimulate the brains of people in the area at the same time as it also influences electrical devices, like light bulbs, televisions, telephones, and computers. People in the area would tend to see strange behavior from electrical appliances happening at the same time as they feel the presence of a frightening entity, and would easily assume that the ghost was also affecting their computers, etc.

As we've seen in our experiments, the way people interpret the sense of a presence can also be affected by the way their brain activity changes in response to the stimulation. In one example, just paying attention to the spot where the presence seems to be and trying to concentrate or "focus" on it can be enough to make it seem to move. Some people would conclude that the "power of their thoughts" made the "entity" respond.

One of the core ideas in modern neuroscience is that we're really only aware of the state of our neurons. It implies that changing their activity evokes changes in states of consciousness, altering the way we perceive phenomena that we're normally unaware of. Both natural magnetic and electromagnetic fields, and the kind we work with in our laboratory, could be present at all times, but we're only sensitive to them when we're in specific states of consciousness, especially when we're awake.

The idea that magnetic fields can affect consciousness and experience has caused some debate in the scientific community. However, we should point out that we do not use homogenous or uniform magnetic fields, and it appears that their complex shape, as well as their movement as we apply them, allows them to affect subjective experiences and elicit EEG activity, even when the subject isn't aware of the nature of our low intensity magnetic signal stimulation.

CHAPTER TEN

Repeated verbal interruptions during exposure to irregular transcerebral magnetic signals elicit irritability: Implications for opiate effects.

[A placebo-controlled, double-blind experiment.]

[Editor's note: "transcerebral" refers to the fact that the magnetic stimulation either reached across the brain, or was able to do so. It was an early term for this kind of magnetic stimulation, and wasn't adopted for all of Persinger's research papers.]

Freeman, J. and Persinger, M.A., 1996. Repeated verbal interruptions during exposure to complex transcerebral magnetic fields elicit irritability: Implications for opiate effects. *Perceptual and motor skills*, *82*(2), pp.639-642.

Summary: 17 men and 18 women listened to a brief story and were then given 30 minutes of either a placebo procedure or stimulation with a magnetic signal [derived from burst firing in the amygdala], applied through a one microTesla moving magnetic field. The field was applied over the left temporal lobe, the right temporal lobe, or both. While undergoing the placebo procedure or receiving the stimulation, the subject's attention to their experiences was interrupted when they were asked to report

> their thoughts in that moment. This magnetic signal had been seen to raise pain (nociception) thresholds and to have simulated morphine effects in rats. [We reasoned that if the effects of this signal were similar to those of morphine, interrupting the stimulation would be an unpleasant experience, and elicit irritation.] We made the prediction that the subjects who received the stimulation over both temporal lobes would report increased irritability, because their pleasant experiences were being disrupted. The results supported our prediction.

One form of aggression is irritability, which may be enhanced when a positive experience ("positive reinforcement") is disturbed or disrupted. We can see this phenomenon in rats, when an ongoing pleasurable experience ("continuous reinforcement schedule") suddenly stops. The same thing happens to people, who protest when ongoing pleasures are disrupted. Our experiments, both with rats and humans, have implied that stimulation with a burst firing magnetic signal across both temporal lobes once every four seconds could be reasonably expected to elicit an opiate-like response. In rats, pain thresholds increase (so it takes more stimulus to trigger pain, an analgesic effect), while human beings show aggressive language, when the stimulation (and its correlated experiences) are disrupted.

Method

This study was designed to test both of these concepts through a single experimental design. If applying this magnetic signal elicits pleasurable experiences, then periodically interrupting the subjects while they're being applied should increase the number of times they felt anger or irritation, as measured using the exit questionnaire. To test this, we recruited 35 volunteers (17 male, 18 female), between 19 and 25 years old. They received a 2% credit in a freshman university class for participating in the study. The experiment used a double-blind protocol in which neither the subjects nor the experimenter knew what the study was for. The laboratory workers and the student volunteers had both been told that it was about how magnetic fields affect memory. The experiment [like all of Persinger's experiments] was approved by the university ethics committee.

After arriving at the laboratory, each subject sat down in a comfortable chair, inside a darkened and acoustically silent chamber. The subjects listened

to a five-minute audio tape that told a story (the “Billy story” [about a child who has an unpleasant nighttime encounter with a foul-smelling humanoid that covers the child, who faints from terror. He finds red marks on his body the next morning. The story is deliberately ambiguous about who or what the being was)]. The subjects received the stimulation or the placebo procedure beginning as the story began, and continuing until 30 minutes had elapsed. Each subject received one of four protocols:

1) A placebo procedure.
2) The magnetic signal over the left temporal lobe.
3) The same signal over the right temporal lobe.
4) Across both temporal lobes.

Four to five men and women participated in each experimental condition. They were told that they would be asked what they were thinking at irregular intervals (“aperiodically”), and that their answers would be confidential.

The magnetic fields carrying the signal were produced from one of four pairs of magnetic coils, activated one at a time. These were embedded in a snowmobile helmet, and arranged so that the magnetic field was carried across the temporal lobes. We also have the option to use the coils only on one side. Having only one of these pairs of coils active at a time allows us to rotate the signal through the coils, which we did once every two seconds. We verified the magnetic field, and measured its strength using a gauss meter that was sensitive to fields up to 10 nanotesla.

After the subjects heard the story, they were each interrupted at irregular intervals between two and three minutes each. The experimenter, speaking through a microphone into a speaker inside the acoustic chamber, asked the subjects to report whatever thoughts were in their minds at that moment. We made records of these reports and classified them as 1) alien abduction themes, 2) sexual abuse themes, 3) details of the story they had heard at the beginning of the session, 4) ordinary or personal thoughts or 5) “nothing.” [The first two reflected two possible interpretations of the Billy story.]

Results

After the stimulation, the subjects were asked to fill out our standard post-session questionnaire that asks them to rate how often 20 experiences and sensations (that commonly occur during this magnetic signal stimulation in

our acoustic chamber). Each question had three answers, 0 = never, 1 = at least once, and 2 = frequently. The questionnaire asked about experiences ranging from “feelings of detachment” to the sense of a presence. We analyzed the answers to the questionnaires in two ways; by gender and by stimulation of the left, the right, both (or neither) temporal lobes. We also analyzed the data about their thoughts in three ways. The first was the number of different kinds of thoughts we found when we interrupted their stimulation sessions with our questions. The second was according to gender, and the third was according to which hemisphere (or both, or neither) was stimulated for each subject. All analyses were carried out using standard statistical analysis software.

When we analyzed the 20 questions on the exit questionnaire, we found that only irritability showed any statistically significant difference from the answers to the same questionnaire in other studies. 51% of the subjects felt irritable more often than we had seen in other experiments. To ensure that our results were specific, the score for irritability was divided by the average for all 20 post-session questions. This second method also verified the increase in irritability, this time appearing 46% higher than seen in other studies. There were no statistically significant gender differences or interactions between the stimulation and gender for the increase in irritability. Further analyses showed that the source for the irritability (the “primary stimulation effect”) was higher when we disturbed the sessions that applied the signal over both sides, compared to disturbing either placebo procedure or during stimulation of only the left [or right] temporal lobe.

[The mathematical treatment of this study appears here, and can be seen in the original publication, referenced at the beginning of this chapter.]

Each subject’s session was interrupted 10 times, for a total of 350 interruptions, for all 35 subjects. The themes of their thoughts at the time were as follows:

Sexual abuse themes = less than 1%.
Alien abduction themes = 4%.
“Nothing” = 15%.
Details of the story they heard = 30%.
Ordinary or personal thoughts = 51%.

[The pleasant effects from the signals may account for the low incidence of thoughts about the story's most unpleasant interpretations; abduction and abuse.]

The themes of subject's thoughts when we interrupted them were about the same for both genders, whether the stimulation was applied to the left, right, or both temporal lobes. Interestingly, the reports of alien abduction themes approached statistical significance, but only for the males who received the stimulation over their left temporal lobe.

The results were in support of our original hypothesis. We suggest that applying this specific magnetic signal (emulating burst firing in the amygdala) to both sides of the head creates an effect so pleasant that interruptions are negative experiences, and therefore elicit irritability [and that this effect may share a common source with some effects of opoid pain medications.]. We find additional support for this interpretation of the results in some our other studies, which have demonstrated elevated mood and reduction in depression for patients in clinical treatments who were given six weekly 30 minute stimulations with the same (burst-firing) signal.

CHAPTER ELEVEN

Control of “Choice” by Application of the Electromagnetic Field Equivalents of Spoken Words: Mediation by Emotional Meaning Rather Than Linguistic Dimensions?

(The brain may be able to “feel” the words around us, even when we don’t hear them.)

Healey, Faye, M. A. Persinger, and S. A. Koren. "Control of “Choice” by Application of the Electromagnetic Field Equivalents of Spoken Words: Mediation by Emotional Meaning Rather than Linguistic Dimensions?." *Perceptual and motor skills* 85, no. 3_suppl (1997): 1411-1418.

Editor’s note: This was a placebo-controlled experiment. However, the subjects had to be instructed on how to respond to short lists of words. This informed them that the experiment was about how they interacted with words, preventing double-blind protocols from being used. The experiment was partially blind, because the subjects didn’t know which words were being used as a stimulus.

Summary: Magnetic field equivalents of spoken words were applied to both temporal lobes of the brain using magnetic coils (the “God Helmet”), so that specific words were received by the brain as magnetic signals instead of sounds. During and after this magnetic stimulation, the subjects were asked to choose either the word that

> had been magnetically applied to the brain or words that shared its emotional connotations, or had the opposite ones, either pleasant or unpleasant, [like *beautiful* and *vomitous*] or active and inactive [like *boulder* or *storm*]. The stimulation subjects chose words with similar connotations 35% more often than the control subjects. This placebo-controlled experiment used seven subjects who received the stimulation and six who received a placebo procedure (without magnetic equivalents for the spoken words). We also discuss the implications of the brain's apparent ability to detect the emotional aspects of words, even when they aren't actually heard, but are instead applied as an equivalent fluctuating magnetic field.

Weak magnetic fields with shapes that encoded meaningful neural information, delivered by magnetic coils over both temporal lobes, have been used to affect subjective experience, including memory and suggestibility. More complicated arrangements for magnetic coils, using even weaker field strengths than we use in our experiments (reaching down into the PicoTesla range), have been shown to have positive effects for patients with disorders involving lasting disturbances in the brain's electrical activity. This research strongly suggests that, when the shapes of the signals used in magnetic neural stimulation contain information that's also at work in the brain, they can change its activity, eliciting subjective experiences and reducing certain neurological symptoms.

In 1961, it was discovered that the brain's auditory system responds to radio frequencies, and can even induce auditory, but not verbal, hallucinations of words. This suggested the possibility that magnetic fields can induce verbal thoughts or even instructions. The concept is compatible with the "Doctrine of Specific Nerve Energies," originally proposed in the 19th century. It says that we are only aware of the state of our nervous system at any given time. It implies that that, if the neuroelectrical activity generated in response to our senses were directly elicited by applying the same signals through neural stimulation, then the experiences that appeared from it would be just as real as experiences coming from our senses.

It appears that spoken words have electric and magnetic equivalents in our neural processes. This suggested an experiment where we transmit

spoken words directly into the brain, by applying their magnetic equivalents. Interestingly, there are anecdotal cases where people have been able to hear radio broadcasts without a radio, although experimental evidence for the phenomenon has been ambiguous. Nevertheless it's consistent with the idea that there are electromagnetic equivalents to the spoken word [otherwise, the direct perception of a radio signal could never translate into voices in someone's head, and the individual would just hear hallucinatory noise. Dental anomalies have also been invoked to explain the phenomenon].

There are three aspects of language, dominated by activity in the temporoparietal areas on both sides of the brain, which we can measure. One of them is the *category* the word might fall into. Most words, especially nouns, fall into certain categories. For example, the word "bear" has more in common with the word "wolf" than it does with either "chair" or "book". [In this way, words can be placed into categories, and the degree of divergence between the categories that encompass two words can be measured.]

Another aspect of single words we can quantify is the emotion they imply (their "affective tone"). Whissell (et al.) showed us that two aspects of language, pleasantness and activation, can be measured. Words can be displayed on a graph with two axes, one showing how pleasant or unpleasant the word is, and the other showing the sense of activity the word implies. We can also see them in terms of how pleasant or unpleasant their connotations are, and how well the feeling of two words might match. [For example, the words "cute" and "cuddly" match each other more than either of them would match the word "itch".] For instance, the words "bribe" or "embarrassing" would belong on opposite ends of the same graph, far away from words like "thanking" or "admiration," even though none of these words are in the same category. "Pleasantness" is independent of category or grammatical type (such as nouns and verbs).

The fact that there are two completely different ways of measuring words, as well as their "feeling" and connotations has some important implications. First, it helps us see into irrational ways of thinking, like the kind that happen in our dreams, where images may appear according to their emotional connotations instead of their categories, syntax, or the perceptions they reflect. Secondly, it helps us see the emotional meaning of experiences

dominated by, and remembered in, the right hemisphere's nonverbal "format," without specific words or images. This idea is especially important for helping us understand how memories reconstruct experiences, especially those of specific events. It implies that the emotional tone [and the personal meaning] of a memory can still be valid, even though its details can be false. For example, in clinical settings, patients describing injuries from memory are more likely to mistakenly attribute them to a person they were afraid of than to one they felt good about. The fear of injury can converge with their fear of the person, and encourage them to unconsciously fabricate ("confabulate") a false or inaccurate memory of the event. Moreover, if the "emotional dimension" of an experience matches that of another experience, there is more chance that the two experiences can be woven into a single memory, resulting in a false accusation.

The existence of these two features of language (categorical and emotional) has a third ramification; that the supports for these two aspects of language may have electrical and magnetic equivalents in the brain. Although individual words usually don't have specific neural representation, their categories and emotional meanings may correspond to specific patterns of electrical and magnetic activity. We created an experiment to test whether it was possible that we could influence the way people "chose" their words, by stimulating the temporal lobes of their brain with magnetic equivalents to spoken words, without the subjects knowing what words we used. We wondered if these irregular fluctuating magnetic fields would have an effect on the mechanisms that mediate our ability to perceive verbal pleasantness and activity; the "feeling" of heard and spoken words. If so, stimulating the temporal lobes with a magnetic signal derived from a specific word should affect the words the subjects chose soon after, so that they would be more likely to choose words that were emotionally similar ("felt" the same) as the word used in the stimulation; the *stimulus* (or "target") word.

Method

Subjects

There were 13 volunteer subjects in this experiment. Six males and seven females. They were first-year college students, between 20 and 25 years old,

who were given a bonus of two points towards their final grade in a psychology class.

Procedure

We selected five words (the *stimulus* words) to be used for each of the 12 subjects. The words were spoken into a microphone and digitized by recording them with an ATI soundcard.

The words were recorded using audio editing software, and a custom interface was used to feed the resulting waveform to the parallel port of a PC computer. This allowed us to feed it through our standard digital to analog converter, which connects to the same parallel port. The output was fed to the magnetic coils that comprise the God Helmet.

Each of the stimulus words was “played” magnetically 20 times, once every two seconds. We chose words with very high measures for “pleasantness” or “activation,” as given in the *Whissell Dictionary of Affect in Language*, which quantifies these qualities. [This meant we were working with words that were measured as being very pleasant, or very unpleasant, or very active or very inactive in their connotations.] The subjects were given printed lists of words, with five different words, including the stimulus word, on each of a dozen pages, yielding a total of 60 printed words. On each of these pages, the two of the words that weren’t used as stimulus words (the “contrast” words) had been chosen for the lowest possible emotional “charge”, or the least amount of activity indicated [In short, the stimulus words were as powerful as possible, and the contrast words were as “weak” as possible.] The stimulus words had high values for *pleasantness* or activation, and the contrast words were very unpleasant or very inactive. The other two words on the sheets of paper were similar in value to the target word, for either pleasantness or activation; but not both. The stimulus word was also included in the lists of words that were given to the subjects.

We tested each subject one at a time. They sat in a comfortable chair, placed in a soundproof chamber. They each wore a motorcycle helmet with four magnetic coils over each of the temporal lobes (the “God Helmet”). The lights were on in the chamber, so the subjects could read. We gave them each a booklet with the 12 lists of words. We told them not to do anything until

they were instructed to, and then to “feel” which words “felt right”. They were also asked to make their guesses slowly [though they were not told what the words felt right *for*].

The stimulus words, presented as magnetic signals, were the same for all the subjects. Each list of five words was presented for two minutes. All of the trials began with the experimenter telling the subject to “turn the page and to feel the word now” for 100 seconds, during and after the stimulation was complete. After this, they were asked to “choose the word.” After another 10 seconds, we asked them to turn the page to see the next list and to “feel the words.”

During these 80 seconds, the magnetic “copy” of the stimulus word was “played” every two seconds. At the same time, the magnetic field that carried the word’s signal was cycled through each of the four magnetic coils on each side, so the magnetic signals moved constantly as they were being applied.

We verified the signal in three ways. 1) Listening to the output through headphones attached to our digital to analog converter 2), Using a voltage meter with a magnetic probe, and 3), using an identical magnetic coil, connected to a sound speaker. For this last verification, current induction from the magnetic signal representing the word was enough to create an audible, though “metallic” sound.

We were testing two hypotheses. The first was that subjects who received the magnetic equivalents for 1) the stimulus word would choose it more often than the ones who received the placebo stimulation. The second hypothesis was that 2) subjects who received the magnetic “copies” of the words via their temporal lobes would choose the words in the list that had similar values for pleasantness and activation as the stimulus word (including itself), more often than the control subjects

Results

We didn’t see any statistical differences between the subjects and controls for the frequency with which they chose the target word. The first hypothesis, (that subjects who received the magnetic equivalents for the stimulus word would choose it more often than the ones who received the placebo), was not

supported.

However, the subjects who were given the magnetic stimulus words, chose words with the same values for *pleasantness* and *activation* as the stimulus word significantly more often (35%) than the two words with the opposite values for pleasantness and activation, compared to the placebo group.

To see whether the magnetic equivalent of words with any particular degree of "power" was responsible for the main effect we saw, we did a two way analysis, examining 1) the differences between the emotional strengths of the words and 2) stimulation versus placebo. This analysis confirmed the main effect, as above. We also found that there was no statistically significant difference between "powerful" and "weak" words, and that this lack of difference applied to both actual stimulation and the placebo procedure. [In other words, it wasn't the "strength" of the word, which correlated with the stimulus word, but rather the emotional *similarity* between the target word and the other words in the lists.]

Discussion

The results of this experiment suggested that applying magnetic copies of a word could influence the selection of other words that share its emotional meanings and connotations. [To put it differently, the subjects who received stimulation of the temporal lobes with the magnetic equivalent of a word as were more likely to choose words that "felt" the same. Although the stimulus word was also picked more often by itself, it was not picked because it *was* the same word, but rather because it had the same values for pleasantness and activation.] Our results did not support the idea that a person was more likely to select the *same* word they had received as a magnetic signal. [We could also say that stimulation of the temporal lobes with a magnetic word had its effects according to its connotations, and not what it denoted. It also implies that the brain can respond to speech, even without hearing it.]

There is very little chance that the effect was an artifact of the experimental methods. If the subjects were *listening* to the stimulus word, even subliminally, we would have seen it chosen more often. Instead, the subjects who were stimulated with magnetic copies of the stimulus words

were more likely to choose words with the same degree of pleasantness or activation. The words had very different sounds and were unrelated in terms of their categories (unlike the words “bear” and “wolf”), making the chance of subliminal exposure to them very small.

One way of interpreting our results here is that electrical or magnetic equivalents of speech could affect behavior, directly from the emotional and cognitive mechanisms supporting human speech. The way people respond (including their feelings, attitudes, or opinions) to the words they hear is primarily determined by their emotional impact [including its “prosody”], without being aware of it or of any verbal imagery. Even though people can identify the reason for their emotional responses to the words they hear, verbal explanations are often rationalized after the fact, and are frequently inaccurate.

One of the hypotheses supporting this experiment was that for most people, the “feeling” of the words we hear involve processes dominated from within the right hemisphere of the brain. These processes are 1) often strongly emotional, 2) frequently inaccurate, when compared to the actual details or images involved, 3) appear rapidly, and 4) can happen without our being aware of them. These attributes of emotionally charged language appear because our “feeling” in response to words that apply, or seem to apply, to ourselves are dominated by processes in the right hemisphere, while our dominant sense of self is mediated on the left side of the brain, where we also find the primary language centers in the brain.

The (1961) experiment, mentioned at the beginning of this article, was done using repeating, symmetrical pulses, and delivered using microwaves. The most likely explanation seemed to be that the brain’s auditory processing areas were responding to the microwaves. This study suggests that information carried as magnetic signals into the brain may not affect our hearing, but they can influence a person’s choices or thoughts without being influenced by any actual “cognition” or decisions. [A fact that many has not escaped many propagandists.]

CHAPTER TWELVE

Enhancing Hypnotic Suggestibility Using a Burst Firing Magnetic signal over the Right Temporal Lobe.

[Placebo-controlled, double-blind.]

Healey, Faye, Michael A. Persinger, and S. A. Koren. "Enhanced hypnotic suggestibility following application of burst-firing magnetic fields over the right temporoparietal lobes: a replication." *International journal of neuroscience* 87, no. 3-4 (1996): 201-207 .

Summary: We measured suggestibility in normal young women and men using *Spiegel's Hypnosis Induction Profile* (HIP) before and after applying a signal derived from burst-firing in the amygdala (observed in deep-brain EEG), and embedded in low intensity (1 microTesla) magnetic fields for 20 minutes. The magnetic coils were placed over the temporal lobes, either on the right, the left, or both, with one of these stimulations per cohort. A fourth group received a placebo procedure. Only the subjects that received the magnetic signals over the right temporal lobe showed a significant increase in their suggestibility after the stimulation session. The results reported here replicate aspects of several different experiments we had carried out previously. All of them imply that results of stimulation with low-frequency magnetic signals are not placebo effects. [It's not possible to alter suggestibility through suggestion.] This experiment supports the conclusion that magnetic signals matching the brain's internal firing codes can directly affect cognitive processes that contribute to hypnotizability.

We use magnetic signals to interact with the brain and affect states of

consciousness. These require 1) low energy magnetic fields, and 2) signals that match those the brain uses naturally in its operation. This interaction occurs if a magnetic signal, applied from outside the head, is close enough to one of the brain's own signals to evoke sympathetic resonance from the neural electrical system. Applying the same magnetic signals to the whole head ("homogenously"), won't be as effective as applying it to specific areas, because many brain processes are dominated by activity in one hemisphere or the other. The pathways that respond to the stimulation include some specific brain areas while excluding others. Most cognitive activity within the brain relies on neural support with an asymmetrical "layout". Applying magnetic fields, embedded with signals derived from known brain activity, can enhance this asymmetry, and should also enhance observable effects on behavior, as well as subjective perceptions and experiences.

However, the *probability* of subjective experiences, and the *degree* of improvement in symptoms that appear after short exposures to magnetic signals could be influenced by placebo effect, arising from subtle cues from the practitioner, as well as the patient's (or research subject's) expectations. More than one researcher has alleged that responses from following short [less than one hour] contact with very low frequency magnetic signals are only placebo effects or reflect a researcher' s bias. This study is to test a third possibility [remembering that we cannot increase suggestibility through suggestion]. Magnetic stimulation, using signals taken from brain activity, may directly modulate the cognitive functions that increase suggestibility. [In this scenario, magnetic stimulation has clear and demonstrable effects, and can elevate suggestion and make hypnosis easier to accomplish.] An increase in hypnotizability after stimulation with magnetic signals could amplify the effects of subtle stimuli from the environment around the patient, including inadvertent suggestions from the person performing the experiment or supplying a medical treatment. This experiment was designed to make this critical distinction clear. [If our results are due to suggestion, then this stimulation will show the same effects whether it's applied to the left, right, or both temporal lobes. Differences in the results from these placements would rule out placebo as an explanation.]

Method

Subjects

48 University men and women, all right-handed, and between the ages of 19 and 21, volunteered for the study. They were told it concerned relaxation, and were not familiar with anyone performing the experiment.

Procedure

The subjects were tested one at a time. We sat them down in a comfortable chair, placed in an acoustically silent chamber. A professional, experienced hypnotist administered the “standardized hypnosis induction profile”. The scores for rating the effects of the stimulation on hypnotizability were based on differences in a group of responses, which we could observe directly, including measuring how far the subjects could roll their eyes upward.

We put goggles over the subject’s eyes to block out all light, and placed a modified snowmobile helmet on their head. Four small magnetic coils were embedded on each side of the helmet. They outlined an elliptical shape, measuring 7.5 cm on the long axis (front to back), and 5 cm on the short axis (top to bottom). We achieved the maximum field penetration in and through the temporal lobes by using a layout that matched their shape. The experimenter left the chamber and sealed the door as soon as the helmet had been placed on the subject’s head. All the subjects were given the same magnetic signal, derived from burst firing in the amygdala, and delivered through the same hardware and software. Four seconds of “magnetic silence” followed each instance of the signal, which lasted approximately one second. The magnetic field carrying the signal rotated through all four magnetic coils on each side every two seconds.

Each subject received just one of the four procedures.

1) A placebo procedure, without the magnetic field active.

2) The magnetic signal over the left temporal lobe.

3) The magnetic signal over the right temporal lobe, and

4) The same signal over both temporal lobes at once.

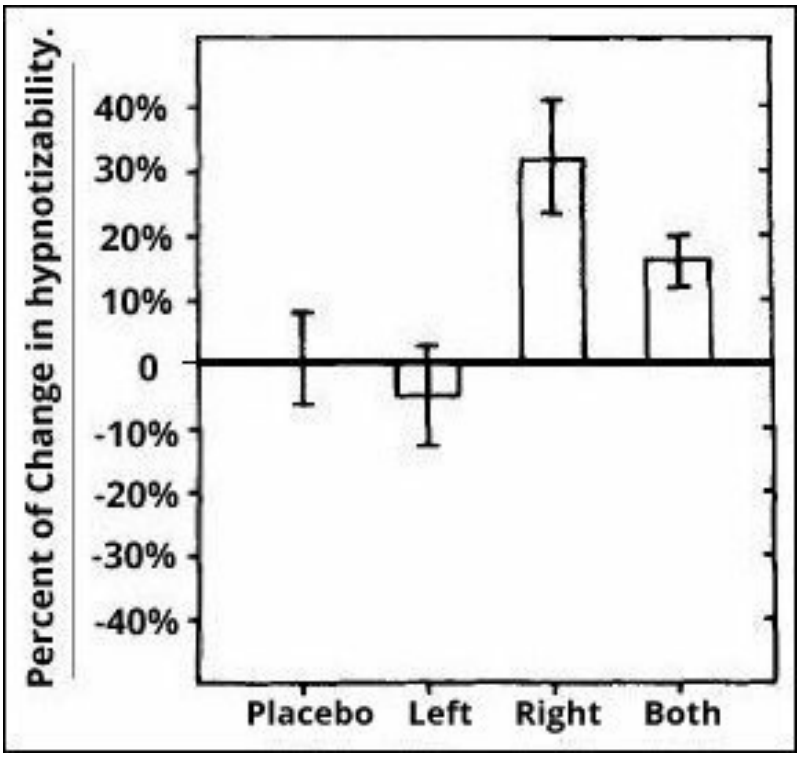
We adjusted the helmet to apply the signal to only one side by flipping a switch, which cut out the voltage to the magnetic coils on the opposite side. The magnetic field, applied only to one side, had a field strength fluctuating between 10 to 100 mG (or from one to ten microTesla, similar to the field

strengths around blow dryers or stereo headphones). The strength of the field over the opposite side (without stimulation) was approximately 90% weaker. Once the stimulation (or placebo procedure) was complete, we took the goggles off the subject, and gave them the *Hypnosis Induction Profile* for a second time. The subjects left the laboratory after this.

We compared the difference between the first and the second application of the hypnosis induction profile to determine how much the subject's hypnotizability had changed. Our statistical analysis included examination of the effects, looking at variations between the four procedures, for both genders separately. Our calculations were carried out using standard statistical software on a normal PC computer.

Results:

Our analyses found no significant differences between men and women for the stimulation conditions, and no differences in their scores for the first time they were hypnotized (before the stimulation). These different stimulations (left, right, or both) showed significantly different increases of hypnotizability. The largest difference appeared with stimulation of only the right hemisphere, which resulted in a marked increase in suggestibility, compared to stimulation of only the left temporal lobe, both temporal lobes, or the placebo ("sham field"). These last three weren't very different from each other. The figure below shows changes for the hypnosis induction scores, before and after the stimulation. The largest increase in hypnotizability (34%) happened for the subjects who received the magnetic signal over only the right temporal lobe. [We should also note that hypnotizability went *down* slightly for those who received the signal only over the left temporal lobe, though the value was small enough to be a "fluke". Other experiments, using the same protocol to study how often the sensed presence experience appeared, also showed a decrease from the baseline with stimulation of only the left temporal lobe.]



Discussion

A previous study obtained a similar result using similar experimental procedures, but applying a different signal (a reversed sine chirp signal). The signal used here (which we've seen elicit responses similar to those from opioid compounds), produced a larger effect size. Derived under double-blind conditions, these results show that response to the hypnotizability test increased when the magnetic signal was applied only over the right hemisphere. This makes it unlikely that the effect was either an artifact of our methods or a placebo, because the results from subjects who received the same signal either over the left or both sides, were similar to those from the subjects given the placebo procedure.

Although we don't have a clear picture of all the neurological and cognitive mechanisms involved in hypnosis, they are likely to involve predominantly right hemispheric patterns of activity. Two common methods of hypnotic induction include touching the right hand or visually tracking objects moving left to right, such as one half of a swinging pendulum's movement. These would also initiate right hemispheric activity (through subtle stimulation of the opposite side of the body or by the demand to keep visual patterns integrated in space, as with a pendulum). People with a hypo-

active (or underactive) left hemisphere, including functions associated with awareness, will be more likely to also have times with hyperactive right hemispheric activity. This can often amount to dissociation and an exaggerated sense of danger ("vigilance"). This experiment was primarily concerned with hypnotizability. However, the hypnotic state involves includes cognitive processes operating with fewer connections to sensory mechanisms than appear in normal consciousness. This implies that the signal used here circumvented the subject's usual sensory pathways. Because this process, like hypnosis, depends on asymmetrical hemispheric specializations, the magnetic coils generating the signals cannot be placed symmetrically; they must instead favor the right side.]

Certain researchers have offered the opinion that faint magnetic fields are unable to create changes in the brain strong enough to elicit subjective experiences. This same opinion obliges them to conclude that any medical benefits or adverse responses are the result of placebo effects. This view seems to be based on a misunderstanding of the neurological and cognitive bases for these effects. The results of this study show that applying a burst firing (one MicroTesla) magnetic signal, has direct effects on suggestibility, which underlies both the placebo effect and hypnosis, and can even amplify them. Consequently, changes in the brain's operations that appear after short exposures to certain kinds of magnetic fields aren't placebo effects, and may be due to enhancements of the electrical processes in the brain that facilitate them, a change that cannot itself be elicited by a placebo.

This result has significant clinical potential. We hope to create alternatives to the somewhat invasive neurochemical (neuropharmacology) approach to treating psychological disorders. One of our working principles has been that the magnetic signals are congruent, or resonate with, electrical activity that supports cognitive and emotional states. In this case, it enhances hypnotizability. Correctly applied, this will make it easier to induce specific brain activities that facilitate adaptive ["sane"] responses to threats or opportunities. The effects we saw from the stimulation explained over one third of the changes we saw in hypnotizability. It offers a significant potential for enhancing hypnosis in clinical settings, and has the potential to make it more effective, raising the effectiveness of instructions given during psychotherapy, as well as helping patients find new ways of thinking about issues and challenges that will endure beyond the therapy session.

This line of research, and its potential for clinical use, has been hampered by imprecise and overly inclusive definitions of what “magnetic stimulation” means. [These usually refer to patent devices used in “holistic” medicine], and fail to include magnetic stimulation designed to interact with specific patterns of electrical brain activity. [This is one reason why this book discusses the stimulation as signals carried by magnetic fields, rather than magnetic stimulation with embedded EEG data.] A similar situation existed in the early history of pharmacology, when treatments were performed with impure substances from unknown sources, and even given without specifying doses. Today, no one would conclude that all medications are placebos because some drug studies have been confounded by placebo effects, and it’s now common knowledge that chemical medications require precise doses. Recent developments both in clinical research and neuroscientific theory indicate that information embedded in low intensity magnetic fields must match the brain’s own internal signals to be effective [and magnetic stimulation that incorporates this principle should be studied separately from other modalities of magnetic therapy].

CHAPTER THIRTEEN

Evidence of human perception of rotating permanent magnetic fields following ingestion of LSD.

[Placebo-controlled]

Persinger, M.A., 1998. “Putative perception of rotating permanent magnetic fields following ingestion of LSD”. *Perceptual and motor skills, 87*(2), pp.601-602.

Editor’s note: This small study contributed to the God helmet experiments by helping to establish that rotating magnetic fields are more effective than stationary ones for eliciting altered state experiences. The three individual experiments reported here involved LSD, an illegal substance, so it wasn’t possible to keep the subjects in a blind experimental protocol. The procedure involved using active magnetic fields, and four placebo conditions: 1) the same procedure with the magnets removed,

but leaving on the motor that turns them. 2) With the magnets left in place. 3) Repeating the procedure a week later, without the LSD. 4) The subjects were not allowed to know whether the magnets, the motor, or both were active at any time.

Summary: Three individuals who had taken lysergic acid diethylamide (LSD) reported seeing diffuse blob-like formations of white, purple, or greenish-yellow lights while sitting alone in total darkness, as two horseshoe magnets were rotated to 3m from the subject, once every two seconds. They didn't report this visual phenomenon when the magnets were either removed or kept stationary. The field strength of these rotating magnets varied between 50 and 500 NanoTesla. There may be an association between the phenomena we report here and 19th century reports of people seeing "magnet lights" induced by ergot consumption.

In 1972 and 1973, two women and one man between 21 and 25 years old volunteered to participate in this study. All had used LSD casually before this experiment. Two hours before they arrived in our laboratory, each of them had taken a single dose of LSD they obtained on their own, and consumed in their homes. Their EEGs (taken with eyes closed) showed us that they had taken enough to stop their normal baseline of alpha rhythms in the occipital lobe. This temporary suppression of their alpha rhythms lasted for the following 2 to 3 days. Each of them sat in a darkened room in a basement laboratory for about 10 minutes. The magnetic field, rotating once every two seconds, had a field strength of 0.5 to 5.0 Milligauss, measured 2 to 3 m away from the magnets.

The magnetic field was produced by a pair of horseshoe magnets, rotating in opposite directions so that they attracted and repelled one another once every with each rotation. We intermittently stopped the motor that turned the magnets. The magnets were attached or removed from the motor at random without the subject knowing. We did four trials, each lasting one minute, for both of the two conditions, at random. We carried out the procedures in complete darkness.

All three subjects said they either saw hazy, diffuse blobs of light, (whitish, greenish yellow or bright purple), alternately separating and merging with a "field" they saw around both of the magnets, approximately once every two seconds. The subjects only reported these perceptions when the magnets were attached and actively rotating. They didn't see them when 1) the magnets were stationary or 2) when the motor was on, but the magnets had been removed. The subject's descriptions of the lights they saw were distinctively different from descriptions of phosphenes or magnetophosphenes. When the same volunteers were given the same rotating

magnetic fields, one week after they had taken the LSD, they had no unusual visual phenomena to report. In addition, EEG revealed that their alpha rhythms, again sampled from the occipital lobe, had returned to a normal baseline level.

No explanations for these reports have been offered, and experiments of this kind, using LSD, are no longer possible. Nevertheless, we can still consider the chemical similarities between LSD and ergotamine as well as recent evidence that, prior to the 20th century, grain contaminated with ergot may have been more common than anyone presently suspects. In addition to this, we should recall the experiences reported in the mid-19th century (from relatively remote areas of Germany) where “sensitives” were said to have seen glows and iridescent luminous displays around magnets, when the armatures were removed from electric motors. These experiences might be explained in terms of the 19th century research which included rating subject’s perceptions of various magnetized substances, as well as their position in the spectrum of electro-negativity (how strongly atoms attract electrons) in modern physical chemistry.

CHAPTER FOURTEEN

Differential Ratings of Pleasantness Following Right and Left Hemispheric Application of Low Energy Magnetic Fields That Stimulate Long-Term Potentiation

[A placebo-controlled, double-blind experiment.]

"Pleasantness: the quality of being enjoyable."

Editor's note: This study is significant primarily because it reports that one signal (derived from the hippocampus) is more pleasant over the right. In contrast, the 'burst-firing' signal (derived from the amygdala) is more pleasant over the left or both sides. This important difference has implications for the limbic system's functional architecture, as well as ruling out suggestibility (which would yield identical results for all the conditions in the experiment) as an explanation for the effects of our God Helmet technology.

Persinger, M.A., Richards, P.M. and Koren, S.A., 1994. "Differential ratings of pleasantness following right and left hemispheric application of low energy magnetic fields that stimulate long-term potentiation. *International journal of neuroscience*, *79*(3-4), pp.191-197.

Summary: Under placebo-controlled, double-blind conditions, a total of 40 normal men and women were exposed to either placebo stimulation or to a magnetic signal carried by a 10 mG (Milligauss) magnetic field, about as strong as the magnetic output from stereo headphones. The signal was known to produce long-term potentiation (memory creation) in slices of the hippocampus. The subjects received the stimulation over the right, left, or both temporal lobes. The ones who received the stimulation only over the right hemisphere rated it as significantly more pleasant than the subjects who received the identical stimulation either over the left or both sides, or who received the placebo procedure. This study took increases in geomagnetic activity into account, because these tended to influence the degree of pleasantness. This analytical procedure helped uncover the actual effect size of the stimulation. The stimulation over the right side proved to be pleasant enough that we also discuss the possibility of using it as a clinical treatment.

Several researchers have explored the possibility that pleasantness and unpleasantness are represented differently in the left and right hemispheres. Stimulating the right hemisphere, either from within, through an epileptic seizure, or from outside, using an electrode to stimulate the surface of the brain during surgery, is often associated with apprehension and "vigilance", the expectation that a threat is about to appear. In contrast, stimulation of the left temporal lobe frequently results in positive emotions. A converse process can create the same result. Thus, damage to the right hemisphere can result in euphoria [if the damage is extensive enough to prevent it from exerting its "dampening" influence over the left side of the brain, inviting euphoria and irritability]. The same kind of damage suppressing activity in the left hemisphere can result in lasting anxiety and vigilance.

In our laboratory, we've been investigating possible treatments for the emotional aspects [as distinct from its somatic components, such as lethargy] of depression and anxiety by stimulating the brain using neural signals carried by low intensity magnetic fields. The structure (or "shape") of these signals mirrors essential electrical activity in the parts of the brain that control mood and emotion. The limbic system (especially the hippocampus and the amygdala) is the primary source of emotions in all primates. It's also very responsive to changes in the electrical activity elsewhere in the brain. If the two hemispheres of the brain aren't equally able to support pleasurable experiences, we should find that stimulation of one of the temporal lobes will be more pleasant than the other. We should also be aware that stimulation of both temporal lobes together may cancel out any effect seen from only one of them.

In order to test this hypothesis, we recruited 40 right-handed volunteer subjects (with handedness defined by the hand they wrote with). These were 20 men and 20 women between 20 and 25 years old. They were students in undergraduate arts courses, who received a 2% bonus towards their final grades for participating. Only one subject received the stimulation at a time. They sat in a large and comfortable armchair, placed inside an acoustically silent chamber. After their eyes had been blindfolded with a pair of opaque goggles, an adapted snowmobile helmet was put on their heads. Each side of the helmet had four magnetic coils, placed above the temporal lobes of the brain. Each coil was wired ("yoked") to the coil in the same position on the opposite side. Each of these pairs was activated for 10 seconds. We used a sequencer to sweep the signals through all four pairs of coils once every 40 seconds.

We used a simple (286 generation) personal computer to generate a very precise signal, which had been seen to double the power of an EEG signature that appears when memories are being created, an increase that lasted for 30 minutes.

Because the geomagnetic field can promote or interfere with the emotional aspects of experience, we also recorded the geomagnetic activity in 3 three-hour time periods; before, during, and after the subject's stimulation session (using data from the *Geomagnetic Indices Bulletin*). To make sure we

could be specific about the timeframe for the geomagnetic influences, we also obtained the daily global value for the earth's magnetic field for the two days before the stimulation session, the day itself, and the day after.

We've worked with the idea that we can amplify the effects of our magnetic signals by reducing the background "noise". *Suddenly* reducing background sounds with our silent chamber and cutting out visual input, by using opaque goggles or a blindfold, releases large numbers of neurons from their normal job of monitoring ambient noise. These neurons can be drafted into the pathways that respond to the stimulation, so that competing sensory input doesn't reduce the effect.

At the end of the 30 minute stimulation session, each subject was asked to rate the experience, as follows:

-2) - Very Unpleasant
-1) - Mildly Unpleasant
 0) – Neutral
+1) - Mildly Pleasant
+2) - Very Pleasant

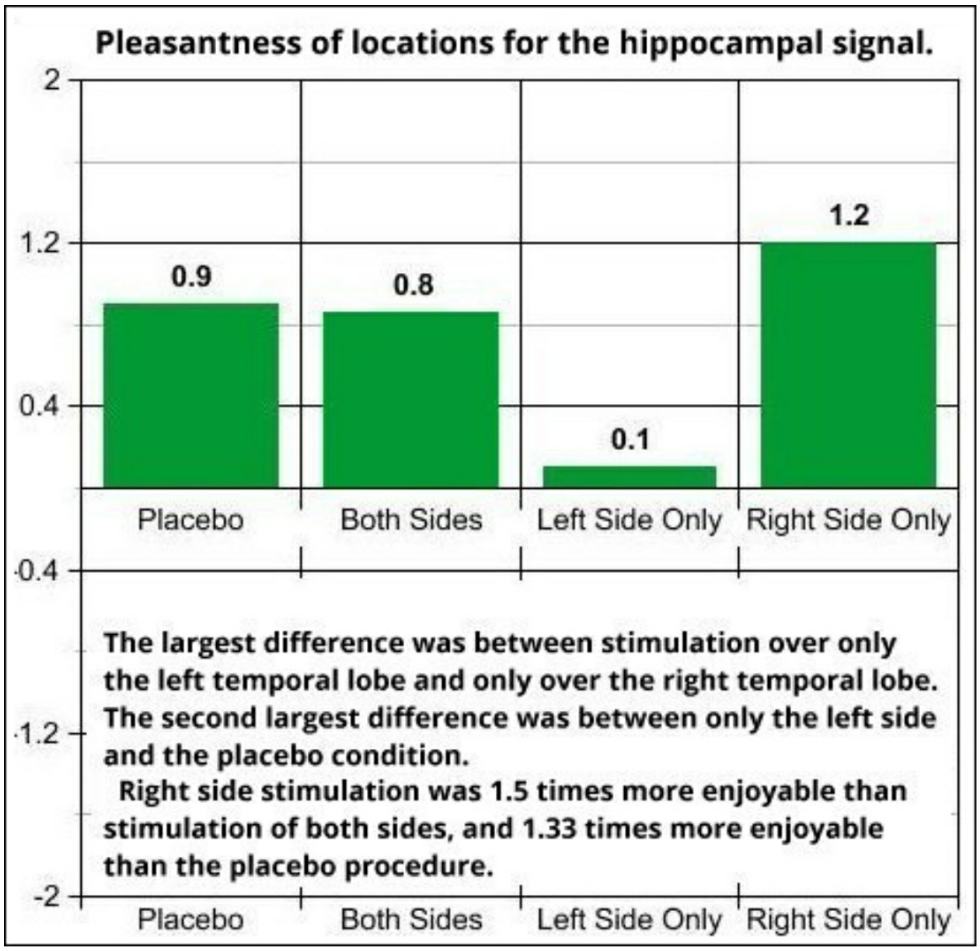
The subjects also ranked how often they experienced various illusions during the stimulation. These included feelings of movement, tastes, smells, sounds, visual phenomena, and experiences related to memory, for a total of 20 items. These were rated on a simple scale of: 1) never, 2) at least once, or 3) frequently. We calculated the average score for all 20 items, and analyzed for these measures according to where the signal was applied, as well as the subject's gender. We also analyzed how the effects varied according to the state of the geomagnetic field during the stimulation. This allowed us to remove any "unpleasantness" attributable the geomagnetic field from our calculations.

The pleasantness scores were checked against the three-hour periods before, during, and after the stimulation to make sure the association between elevated geomagnetic activity and reduced pleasantness was accurately calculated for the time of the stimulation sessions. The geomagnetic activity just before the experiment was also statistically significant. The daily average values for the earth's magnetic field during the stimulation sessions had a

significant correlation, but not the values for the three days before or after the stimulation.

Results

When we analyzed the results, we found that there were no significant differences for gender, though there were statistically significant effects for the stimulation overall. The effect became stronger (increasing by 5%) when the influence of increased geomagnetic field strength was subtracted from the degree of unpleasantness. Greater activity in the earth's magnetic field at the time the stimulation correlated with lower pleasantness ratings. The most significant difference was between the group that received the stimulation over the right temporal lobe, and the group who received it over the left temporal lobe. Stimulation across both temporal lobes gave us pleasantness scores that were the same as for the placebo procedure.


Pleasantness of locations for the hippocampal signal.
2
1.2
0.4
-0.4
-1.2
-2
0.9
0.8
0.1
1.2
Placebo
Both Sides
Left Side Only
Right Side Only
The largest difference was between stimulation over only the left temporal lobe and only over the right temporal lobe. The second largest difference was between only the left side and the placebo condition.
Right side stimulation was 1.5 times more enjoyable than stimulation of both sides, and 1.33 times more enjoyable than the placebo procedure.
Placebo
Both Sides
Left Side Only
Right Side Only

To uncover the largest effect size for only the magnetic signal stimulation

alone, one of our analyses compared only the three groups that received the magnetic signal treatments. We also checked our results against the state of the geomagnetic field at the time of stimulation, as well as the person's scores for temporal lobe signs (such as déjà vu, sensing a presence, nighttime moments of creative inspiration, etc.)

These phenomena are similar to the experiences reported by people with temporal lobe epilepsy, and may reflect a fundamental brain process that allows geomagnetic activity to reduce melatonin levels, making seizures that begin in two very sensitive brain parts, (the amygdala and the hippocampus) more likely. [The same process will also increase temporal lobe sensitivity overall, especially for those whose temporal lobes are more sensitive than average, but still below the threshold for seizures and epilepsy.]

We gave the subjects our questionnaires for temporal lobe signs between two and six weeks before the experiment in a classroom setting, not in a laboratory. The students weren't told that their answers on the questionnaires would play any role in any upcoming experiments. Taken as a whole, the subject's answers to the questionnaire were within the normal range.

Put simply, on a scale from -2 to +2, stimulation of the left hemisphere (using this magnetic signal) had a pleasantness rating of +0.1, while stimulation of the right hemisphere had a pleasantness rating of +1.2, making it approximately 10 times more pleasant. Stimulation over the left temporal lobe wasn't rated as unpleasant. [Rather, stimulation of the *right* temporal lobe was rated as significantly more pleasant. We should consider the experimental context. Being placed in silence and darkness is, for most people, intrinsically enjoyable, due to its ability to relieve stress.] Overall, women were more likely to report the sense of a presence in this study than men were, but the effect did not reach statistical significance, given the number of subjects. [The actual math, along with the standard deviations, can be seen in the original paper, referenced at the beginning of this chapter. The conclusion from the numeric data, following our original inquiry, is that pleasantness and euphoria are represented differently on the two sides of the brain.]

Discussion

The results from this study appear to support our hypothesis that, in order for magnetic signals to have an effect on emotional states when applied to the temporal lobes, they must be applied asymmetrically, so that the stimulation doesn't affect the left and right sides of the brain equally. However, the left/right "direction" of the emotional response was the opposite of what we expected. [A few years later, a depression study *using a different signal* found that stimulating both temporal lobes reduced depression and phobias.] The subjects who received stimulation over the right temporal lobe reported that the experience felt more pleasant than it was for those who received the same stimulation over the left temporal lobe. It's not likely that the outcome was influenced by the experimental procedure, because of how substantial the effect was, and because of the placebo-controlled, double-blind procedures we used.

[There is more than one way to explain how stimulation of the right side of the brain could be more pleasant than stimulation of the left, in spite of the fact that the right side of the brain, including the right amygdala, (specialized for fear), is usually associated with negative emotions.] It's possible that stimulation of the right temporal lobe evoked activity on the opposite side of the brain. [In another scenario, the right hippocampus may be specialized for pleasant and positive thoughts, and the effect seen in this study is due to its direct stimulation.]

If the pleasantness of stimulating the right hemisphere with this signal had to do with response from the amygdala, then the effects could be a milder instance of an orgasm-like experience that have appeared when electrically sensitive areas in the right limbic system are activated. These tend to slow right hemispheric activity during orgasm, (as seen on EEG), compared to the activity in the left hemisphere. It's been suggested that the right hemisphere dominates the brain's activity during dream sleep, where very pleasant and orgasmic experiences can happen. However, we should also take note that recruiting one area in the hippocampal region (the *right parahippocampal gyrus*) into dreams (the REM state) tends to evoke anxiety and panic. As it happens, fear is the most common emotion in our dreams. There is an intensity threshold with direct *electrical* stimulation, where its results can first become increasingly pleasant, and then collapse, eliciting displeasure

and panic. This illustrates the non-linear effect of electrical brain stimulation (not used in our laboratory), and a similar mechanism could have come into play in this experiment.

[In discussions with Dr. Persinger several years after this experiment was published, Persinger informed this book's editor that he was convinced that the hippocampus on the right side is specialized for pleasant cognitions, and this signal was directly stimulating the right hippocampus, with its very cognitive functions, in this study. The right hippocampus is associated with trance states, meditation, deep relaxation, dream imagery, and imagination. These are nonverbal ways of thinking ("cognitive modes") with a high degree of pleasantness. We would expect their direct activation via stimulation with a hippocampal magnetic signal to be markedly pleasant. Conversely, the nonverbal environment of our experimental conditions would be incongruent with the verbal mental tasks to which the left hippocampus is adapted. Stimulation with a hippocampal signal over only the left temporal lobe could easily emerge as unpleasant. We hope to see further research in this area.]

The real goal of this kind of research, as other scientists have suggested, is to use these procedures to enhance or even replace psychiatric medications. Interestingly, magnetic signals like sine or square waves, which apply the same patterns repeatedly in very short periods of time, have not been effective in our work with low intensity magnetic fields. They require very high field strengths to be effective. For example, TMS (*Transcranial Magnetic Stimulation*) uses magnetic fields 1 million times stronger than the ones we use. We have found that weak, irregular magnetic signals that imitate firing patterns found in specific brain structures are effective, even from stimulation lasting just a few seconds. The stimulation may appear to be quite "diffuse", but psychiatric medications, dispersed through the blood supply for the whole brain, display degrees of diffusion similar to a magnetic field applied to the whole brain. The field energies in any individual area of the brain may be very small, but the amount of a medication in the same space is also quite minute.

The critical feature of our stimulation is the information embedded in the magnetic fields. To have an effect, the fields need to embody information that's relevant to at least one neurological or biological process. The field

must contain information that the brain, or one of its parts, can understand ("biorelevant" information). This is more important than the strength of the magnetic field that carries it. Similarly, you're more likely to respond to hearing someone say your name quietly than someone else's name loudly. This study applied a signal that the brain can recognize as a part of its own memory processes, but it felt best when applied only to the right temporal lobe. The same information, fed to both sides at once, didn't have the same effect. It's possible that even more focused stimulation, using a more refined signal, could create even more powerful effects, and this should be evaluated carefully. The limits of this study did not allow us to estimate how long the effect lasted. Some of our other work has suggested that the effects may endure [long enough to constitute a viable psychiatric treatment] if the stimulation is given twice a week.

This experiment is part of our larger effort to find the physical and functional bases for human thought and emotion. The large-scale structure of the human brain [as well as multiple studies in functional neuroanatomy] suggest that pleasant and unpleasant "meanings" (which direct our emotional responses to events) are assigned in the limbic system, especially in the amygdala. Other parts of the brain participate, including the lower (ventral) areas of the surface of the two hemispheres, mostly through the anterior commissure, a structure that connects the temporal lobes and the amygdala on each side. Verbal thoughts about events that inspired an emotional response reflect activity on the surface of the brain (especially the left, with its language centers), with contributions from both hemispheres through the corpus callosum, the information superhighway that connects the two sides of the brain.

In most moments, our emotions and thoughts are activated together or come very quickly after each other. The results of this study, together with some of our previous work, imply that the emotional tone of the words we use to describe our experiences, as well as how pleasant they feel to *us* can change, even though our actual experiences remain the same. [Our emotions affect our thoughts ("cognitions") more than our perceptions.] This explains why there were no differences in how *strong* the illusions that appeared from our stimulations (left side, right side or both sides) were.

Some brain scientists have suggested that agreement between our thoughts and emotions, as well as coherency between the brain structures that support them, is a necessary feature of human consciousness. If this is correct, then although we don't know how such a thing could be accomplished, disconnecting our thoughts from our emotions could affect our states of consciousness and mental behavior without our knowing about it. A technology that creates predictable changes in what people find pleasurable could have medical and political ramifications, since emotional factors often influence serious decisions, especially in the absence of rational thinking.

Our analysis of the influence of geomagnetic activity revealed that the stimulation was less pleasant when the geomagnetic field was more active. There is a similar connection between increased geomagnetic activity and epileptic seizures. Both phenomena could at least be partly explained if negative experiences are associated with an increase in the sensitivity [responsiveness to stimuli] of the amygdala and hippocampus. The size of the connection between unpleasantness and geomagnetic activity in this experiment was comparable to what we'd seen in some of our other studies.

The measures for geomagnetic activity are actually somewhat crude estimates of its strength. They don't tell us which frequencies could be embedded in it. However, we suspect that there are signals embedded in the earth's magnetic field that appear and disappear when it gets stronger or weaker. Monitoring increases and decreases in the geomagnetic field strength is a bit like turning a radio's volume up and down while scrolling the tuning dial back and forth. You can tell that a lot is going on, but you don't know what it is. Something similar happens in EEG interpretation, where it's easier to see specific frequencies when the brain (or specific places in it) is less active. The "louder" the EEG reading, the more difficult it is to see its frequencies. [We should note that the development of quantitative EEG has reduced this limitation.]

The observation that we know how the brain responds to changes in the strength of the earth's magnetic field, but not the information it might contain, has three implications.

1) Geomagnetic activity may have a greater impact on our emotional

states than we've known up to now. However, this would occur within our normal brain processes, which would tend to mask it. It can be refined by removing competing sensory information, and allow it to be observed clearly. We apply this principle with our subjects by doing our sessions in an acoustically silent Faraday (free of electromagnetic pollution) chamber. The "noise" (auditory, visual, and electromagnetic), is removed from the procedure in order to improve the "signal-to-noise" ratio for the effects of our stimulation. Even isolating the pleasurable effects of this magnetic signal required that we take the influence of the geomagnetic state into account

2) The response to both our magnetic signal and the earth's magnetic field may be managed by the same brain processes, operating in different contexts.

3) This kind of stimulation may find application in enhancing immune system function, given that increases in immune activity have been associated with left hemispheric excitement, and decreases in immune system function are similarly associated with right hemispheric excitement. The results of this study imply that focusing magnetic signal stimulation on the left side of the brain may offer a worthwhile approach to immune system enhancement. We should take note that, in this case, stimulation over both temporal lobes of the brain had the same effect as the placebo procedure. Using stimulation with this limited scope and greater specificity, (applying the signal to only one area of the brain) may help explain one researcher's success in treating autoimmune diseases, including multiple sclerosis, using complex signals embedded in magnetic fields even weaker than the ones we have used in this experiment.

CHAPTER FIFTEEN

Weak, but complex pulsed magnetic fields may reduce depression following traumatic brain injury.

Baker-Price, L. A., and Michael A. Persinger. "Weak, but complex pulsed magnetic fields may reduce depression following traumatic brain injury." *Perceptual and motor skills* 83, no. 2 (1996): 491-498.

[Clinical questionnaires, taken before any treatments, were used as control data.]

Editor's note: This study is actually four case histories, and four subjects aren't enough for placebo controls. The authors responded to their success in

this experiment, and the fact that the number of subjects was so low, by performing a similar experiment several years later with a larger group, where EEG data before and after the treatment was compared. The results of that experiment are also included in this book. Note that a section discussing electroconvulsive therapy has been removed from this paper, due to changes in that therapy in the approximately 20 years since this paper was written.]

Summary: Many patients who experience lasting depression soon after a brain injury don't respond well to antidepressant medications. We developed a hypothesis that this kind of depression will appear along with signs of brain activity similar to epileptic seizures, especially in two deep (limbic) structures; the hippocampus and the amygdala. The depression may continue for months or years after it looks like the patient has recovered from the injury. In this study, we worked with four patients who had mild to medium impairment of their brain function, according to standard tests. They received neural stimulation using a signal taken from burst-firing in the amygdala, carried by a weak (1 microTesla) magnetic field. The signal was applied to both temporal lobes once a week for five weeks. The results showed a significant improvement in their depression and phobias. However, physical symptoms and other complaints didn't change.

Symptoms of depression often develop in the aftermath of traumatic brain injuries. The medications doctors prescribe for these patients, hoping for successful treatment, are tested in clinical trials that aren't well-suited to head injury patients. Instead, most of these studies worked with patients who became depressed because of psychological and social problems. The kind of depression that appears after concussions and brain trauma can be the result of changes in the brain's electrical and chemical activities. These are different from the typical depression that appears when synapses alter in response to aging or undergo depressing social and psychological problems.

Over the 10 years from 1986 to 1996, our research group has worked with the idea that mild to medium brain injuries can create symptoms also seen in one kind of epilepsy (*complex partial epilepsy*, also known as *temporal lobe epilepsy*). Its seizures commonly begin deep in the brain's limbic system. This concept partly comes from the premise that a heavy blow to the brain is

likely to remove or disturb synapses that ordinarily inhibit communication between brain cells. [When inhibitory synapses are removed or damaged, they can no longer inhibit any activity, leaving the damaged brain area more excitable than before, especially in the limbic system. its greater sensitivity to stimuli puts it at a higher risk for this kind of “microstructural” damage than the outer layer of the brain.] When this happens, the result can be 1) an increase in cortisol, the brain’s “stress chemical.” (Following increases in *corticotrophin releasing factor*), 2) frequent disturbances in the amygdala and hippocampus (which provide the deep brain foundations for our thoughts and emotions), and 3) a decrease in the two hemisphere’s ability to inhibit one another. These moments when the two sides of the brain can’t control one another can appear as “sudden depression or panic,” the feeling that there’s a malevolent presence near a person, or sensations that seem to be coming from outside the person, even though they originate in their own brain.

Extreme or long-lasting disturbances in the hippocampus and amygdala can behave as mild instances of temporal lobe epilepsy. They can be “subclinical;” not strong enough to qualify as actual epilepsy, and emerge as a failure to create memories of our present experiences [“brain fog”]. [Patients like this might be unable to remember thoughts and events from just a few minutes earlier.] The patient would also be unable to remember much from the time just after the brain injury (“posttraumatic amnesia”). There will also be shorter intermittent episodes of “memory blanks,” well after clear clinical signs of recovery have appeared. Very often, their spouse may report that they have trouble remembering things. These episodes can go on for years after the brain injury and can become worse following stressful events. At the same time, the patient “stresses out” more in difficult moments than they did before their brain injury.

There are a few observations that support the idea that brain injuries can lead to a syndrome with features of temporal lobe epilepsy. One third of patients who have this kind of epilepsy also show depression, although it’s often mistakenly seen as coming from psychological causes. Measures of brain physiology have found that many depressed patients have higher metabolism in the amygdala and the hippocampus. They also show decreased

metabolism in the left frontal lobe and both temporal lobes. Further, anti-epileptic medications have been used successfully to treat depression. These observations appear to support our idea that a large number of depressed patients have some electrical and chemical processes in common with those who have limbic or temporal lobe epilepsy. Here, we're working with the idea that most patients with persistent depression, appearing after a brain injury, also have extra sensitive limbic systems (like those with temporal lobe epilepsy), with all the troubles that can create, like memory issues, depression, and becoming overly stressed in response to minor difficulties.

Magnetic fields reach through the brain easily [it's a law of physics that nothing can impede a magnetic field], and they've been proposed as a possible way to influence the brain cells responsible for depression. Some researchers, thinking only of the principles of classical physics, incorrectly believe that it will require very strong magnetic fields. Others have assumed that, if the left frontal lobe malfunctions in depression, then high-powered (one Tesla) magnetic fields will activate brain cells in this area, and improve the symptoms. The same researchers theorized that applying these very strong magnetic fields (TMS) to the left frontal cortex to six patients every morning for five days with primary mood disorders (and who didn't respond to antidepressant medications) would decrease the symptoms of depression by 70%. However, only two of the six patients in their study showed any clinical improvement. [In this case, simple magnetic fields were applied. We should take note that the effectiveness of TMS has improved significantly since this was written.]

We have argued that the information content of the signal embedded in the magnetic field is more important than the field strength. In our view, the pathways that control thought processes in the brain have information patterns that respond with a sympathetic resonance when they are stimulated with the right information. [A simple metaphor can clarify this. You'll have a stronger response to your own name than the name of a stranger, whether your name is shouted or whispered. The actual stimulus might be a sound wave, but you respond to its information, not it's "carrier".] There are often differences in the research methods that emphasize the strength of a stimulus and those that emphasize its meaning. We see this in the difference between

high-powered magnetic stimulation (TMS), and the magnetic signals we use in our laboratory. Of course, the fact that one treatment works doesn't mean that other treatments won't. [The advantage of the method used in this study lies in its being less intrusive, because it doesn't require such strong magnetic fields, as well as its ability to "target" the limbic system.]

Depression following traumatic brain injury can be treated by stopping the instability in the deep (limbic) temporal lobes that also elicit *temporal lobe signs*. [These include sensations of déjà vu, the sense of a presence, tingling sensations, and illusions of movement while falling asleep, and are called *temporal lobe signs.*] It can be accomplished with far weaker magnetic fields if they include the right pattern [taken from "signature" signals from the limbic system]. However, the treatment should be more effective if it begins soon after the injury, before the number of brain cells altered in the aftermath of the head injury reaches a critical threshold, through "kindling" (a process where past episodes make future episodes more likely). A year before this study was published, we reported we could raise the threshold for overt limbic seizures, making them less likely, in laboratory rats if we exposed them to a pulsed magnetic field once every two or three days. When people are exposed to a similar magnetic signal, they report experiences similar to the ones seen from direct stimulation of the surface of the brain using an electrode, including the experiences (*temporal lobe signs*) that help diagnose temporal lobe epilepsy. These didn't produce any negative effects in normal volunteers, including, in one study, four 30 minute stimulation sessions, once a week for four weeks. [The same absence of negative effects, continued to be borne out over the decades following this study.]

The purpose of this experiment was to see if we could reduce depression in patients who exhibited mild to moderate brain impairment after a verified traumatic brain injury, using a weak magnetic field that includes an embedded signal, taken from an amygdala burst firing pattern. We reasoned that it would be particularly effective with those who developed depression after a concussion, which usually disturbs the connections between the limbic system and the brain's surface. A good metaphor to understand this is that aspirin is most effective when given for a fever or inflammation, but has little effect if a person isn't in any pain. [Communication between the frontal lobes

and the amygdala are disrupted in many brain injuries, and so the amygdala's normal signals don't "get through". Applying one of its signatures embedded in a magnetic field from outside the head, can help to reestablish the communication, because the affected brain cells can also resonate with the same pattern. We "jog" the amygdala into activity by calling out one of its names, so to speak. The result is an increase in the amygdala's communication with the brain's surface (the *cortex*), reducing the symptoms of depression.]

If these low intensity magnetic fields, with their complex shapes, are effective enough for clinical use, we should see significant effects after stimulation once a week for five weeks even with only four subjects. On the other hand, if there was no significant improvement during this period, then the chances for supplementing [or replacing] chemical treatments with our magnetic stimulation would be very small.

Two men, aged 34 and 37, and two women, aged 40 and 45, were referred to Ms. Baker-Price, the first author of this paper. All of them had sustained closed head injuries from one to six years before the treatments began. They had completed neurological and psychological assessments, which found mild to moderate brain impairment in several standard tests (including *dichotic listening* performance). They also showed abnormally high scores on questionnaires that asked about temporal lobe signs (déjà vu, etc.). All four patients had reported persistent or frequent but intermittent depression (often beginning suddenly). This was diagnosed by their doctors, who found that they had not responded to antidepressant medications

The patients were considered eligible for this experimental treatment because all available medical options had been exhausted, and because they fit the criteria for the experiment. Each one volunteered only after all the potential risks and benefits had been fully described. The consent form said 1) the application of these fields were pleasant. 2) There was no clear evidence that short exposures to these fields had any long-term adverse effects. 3) They could withdraw from the experiment at any time. 4) They could call Dr. Michael Persinger if any questions or symptoms appeared. 5) The treatment would be given to the patient at no cost.

Each patient met with one of the experimenters once a week for five weeks, always in the same room. After a brief conversation, the patient completed the *Beck Depression Inventory*, The Symptom Checklist-90 and two other questionnaires, one of which asked about physical symptoms. We gave the subjects the questionnaires at the beginning of each session to see how the effects lasted over the previous week, rather than asking them how they felt immediately after each session. The patient sat in a comfortable overstuffed chair, placed in an acoustic (*completely* soundproof) chamber. The complex burst-firing (amygdala) magnetic signal was applied with a field strength of 1 MicroTesla, using simple magnetic coils ("solenoids"). These were located over the superior temporal lobe region. The coils were embedded in small plastic containers attached to the head using Velcro strips. The field and the signal it carried (lasting approximately ¾ second), was applied once every four seconds. The signal and its shape were controlled by a 286 series PC computer. At the end of the 30 minute session, the experimenter talked over any concerns the patient may have had during the previous week, and offered suggestions for coping with ordinary life problems. The entire visit to the lab took about an hour.

We recognize it would've been ideal to also use our control condition (a placebo; - where the cable from the computer to the magnetic coils is disconnected). However, our concern for the condition of the patients, as shown in their responses to our questionnaires on depression and anxiety [as well as the small number of subjects], dictated that we give the procedure to all of them. We believed that the problem of placebo effects would be partially addressed by requiring that the effect size must be extremely large. A 50% reduction of the symptoms of depression over five weeks would exceed any possible placebo effect, especially if the changes in their scores for the depression (and other) questionnaires were stable. Many researchers would have advised the subjects be randomly placed in two groups, one with stimulation, and one without (in a sham-field control group). We concluded that treating all of the subjects and then measuring the effectiveness of the treatment on their scores for depression would satisfy both the experimental and ethical requirements. [So long as the effect size is significantly higher than the size for placebo effect, the latter can reasonably (though not completely) ruled out. Nevertheless, we repeated the experiment four years

later with a larger subject group, and corroborated the results using EEG monitoring. We also followed up six weeks after the stimulation session was completed. In addition, the duration and severity of these patients' symptoms made it unlikely that they could be "fooled" by a placebo. Indeed, placebo treatments are not effective in depression over time.]

We analyzed the results of the experiment using standard statistical software, including the scores for the *Beck Depression Inventory*, the questionnaires for physical symptoms and the scores for nine scales (compulsion, phobia, hostility, depression, anxiety, paranoia, Psychasthenia {a psychological disorder characterized by phobias, obsessions, compulsions, or excessive anxiety}, and psychotic episodes). We should note that there were no gender differences in the results.

Results

There were two significant changes. We found a significant improvement in the subject's depression, as measured by the *Beck Depression Inventory*. This came to a 67% reduction of their symptoms over the five weeks of the experiment. We also noticed that the most significant improvements in their symptoms happened between the first two sessions. There was also a 76% decrease in phobias between the beginning and the end of the experiment (as measured by the symptoms checklist-90). None of the other symptoms we examined [which weren't prominent features of their disorders] were significantly reduced.

Discussion

The results of the study show that these four patients with persistent depression, and higher than normal temporal lobe signs (déjà vu, etc.) had a positive response to our procedure. The effect was quite specific, both in their scores on the Beck Depression Inventory, and a scale that allowed us to infer the level of their phobias. One of our other questionnaires also asked about depression [with fewer questions], and showed a 60% reduction in depression, in contrast to the results from the Beck Depression Inventory, which came to a 67% reduction in depression symptoms.

Our study had a few limitations. Besides the absence of (placebo)

controls, we didn’t assess the continuity of the effects one week and 10 weeks after the treatment had been completed. In addition, the effects of the discussion of personal issues after each session can’t be removed from the results. (One patient sent an unsolicited letter expressing their appreciation for the treatment and the improvement in their depression, and conveyed their thanks to Ms. Baker-Price.) We should mention that we also worked with 11 more patients in unpublished data and qualitative evaluation of their results also show a degree of improvement that doesn’t normally happen within five weeks, even with weekly contact with health professionals. Other experimental designs (like A-B-A-B), though methodologically elegant, weren’t as ethical. They would have involved fewer stimulations, which would have interfered with the effect. It would have been impossible to maintain the positive effects of the treatment with its reduction of depressive and other unpleasant symptoms, if we had changed its continuity.

In spite of these limitations, we found that low intensity magnetic field stimulation with a burst-firing pattern may inhibit the deep brain electrical activity that creates depression and could supplement [or in some instances, replace] normal therapeutic techniques.

There is now both theoretical and empirical evidence that complex magnetic fields with wave structures and pulse patterns that echo the shapes of electrical activity in specific areas of the brain can improve brain function in human beings. As we have seen in this paper [and its later replication], there are also be psychotherapeutic effects. For example, we’ve seen that applying complex magnetic fields to the right side of the brain in normal volunteers can enhance hypnotizability. The size of the effect is enough to augment the effects of brief discussions (“talk therapy”) about the patients’ behavior by making their perceptions about themselves, their explanations for their own personal problems, and the solutions to them more rewarding. [The effect size may have contributed to the decision not to gather data immediately after the sessions.]

CHAPTER SIXTEEN

Intermittent burst-firing weak (1 microTesla) magnetic fields reduce psychometric depression in patients who sustained closed head injuries: A replication and electroencephalographic validation

Baker-Price, Laura, and **Michael A. Persinger**. "Intermittent burst-firing weak (1 microTesla) magnetic fields reduce psychometric depression in patients who sustained closed head injuries: A replication and electroencephalographic validation." *Perceptual and Motor Skills* 96, no. 3 (2003): 965-974.

[Baseline EEG and answers to questionnaires were used in place of placebo controls.]

(Note: 1 Microtesla is equal to ten Milligauss, another commonly-used measure for magnetic fields.)

Editor's note: This study compared stimulation of just the left frontal lobe to stimulation of both temporal lobes for people with depression after a brain injury. The temporal lobe stimulation was more effective. EEG showed an increase in beta activity six weeks after the treatments were complete. Instead of comparison to placebo controls, this study compared two different groups of subjects to each other, and compared post-treatment EEG recordings to a baseline, taken before the treatment began.

Summary - 14 patients, victims of closed head injuries, who then developed chronic depression, lasting over a year, were given neural stimulation with a magnetic signal based on a burst firing "signature" in the amygdala, the brain's primary emotional structure. The stimulation used a weak (one microTesla) magnetic field. These were applied using magnetic coils, over either both temporal lobes or over just the left frontal lobe. The stimulation sessions lasted 30 minutes and were given once a week for six weeks. Their scores for depression were found to be reduced following five weekly sessions (scores were taken *before* the stimulation), and again after six weeks with no treatment. The changes in the depression scores for these patients were approximately the same for both groups (temporal versus frontal). Following this treatment, we also found that minor altered state experiences (*temporal lobe signs* such as déjà vu and sensing a presence) happened less frequently for the seven patients who received stimulation over both temporal lobes. EEG measurements, taken six weeks after the treatment was finished, for

the seven who received the stimulation over both temporal lobes, were stronger in the 16 to 18 Hz (beta) range in the occipital, prefrontal, and temporal areas.

In 1996, we reported that six weekly sessions applying an amygdala burst firing signal, embedded in a magnetic field across both temporal lobes, significantly reduced depression (as measured using the *Beck Depression Inventory*) in patients who had sustained closed head injuries. *Transcranial Magnetic Stimulation* (TMS), also used for depression, involves applying very strong (1 Tesla) magnetic fields over very small areas of the brain. TMS uses simple shapes for its magnetic fields [like a 100 Hz "train"]. In contrast, our low intensity magnetic field stimulation uses signals with complex, [irregular] shapes, and field strengths a million times less intense. Nevertheless, the two treatments are about equally effective. A more recent study with clinically normal volunteer subjects showed that applying this magnetic signal over both temporal lobes once a week for three weeks (but not for three consecutive days) created mood improvements in the volunteer subjects.

This experiment was designed to see if stimulation with a magnetic signal (derived from burst firing in the amygdala), over the left prefrontal region, would be as effective for depression as applying the same signal over both temporal lobes. We chose the left prefrontal region for comparison because the neurological profile for clinical depression involves reduced function of the prefrontal areas of the brain [including reduced blood flow, especially on the left side]. Applying repetitive TMS over the left prefrontal lobe has been associated with increases in blood flow in that area.

Over the years, we've seen that more than half of all the patients showing depression and pain in the years after "mild" brain injuries have not responded to antidepressant medications. We suspected that this resistance to medication may involve the way doctors choose antidepressants for their patients. Such drugs, developed for marketing, are usually based on the results of clinical trials with patients with depression following the loss of a loved one, slow gradual changes in the brain, or other common origins. [Depression following head injuries, including concussions, can appear suddenly following injuries, and doesn't match the typical pattern for clinical

depression.]

Our hypothesis has been that a substantial portion of patients who experience depression and pain following a closed head injury (with or without loss of consciousness) don't respond to antidepressant medications because their symptoms are due to *increased* metabolism and electrical activity in the limbic system, deep in the temporal lobes. This would especially apply to the hippocampus and the amygdala, rather than a more general *decrease* in metabolic activity [including as blood flow] in the frontal lobes, especially on the left side. [In other words, most clinical depression involves *diminished* activity in the frontal cortex, while depression following head injuries is more likely to come from *increased* activity in the temporal lobes, especially in its deeper structures.] When the limbic system dominates brain function, we expect to see reduced metabolic and electrical activity in the prefrontal areas of the brain, creating the same kind of reduced function we see in normal clinical depression. When we applied the same magnetic signals used in this study to specially bred laboratory rats, we found that the incidence of seizures, beginning in the limbic system, had been reduced.

One of our previous studies [but using only four subjects,] found a significant reduction of depression and phobias, applying the same signal used here, but only over the temporal lobes. The effect was significant enough that we reasoned that a sample of 14 patients would allow us to see any differences between applying the magnetic signal over the temporal lobes and the same stimulation over only the left prefrontal lobe. For humane reasons, we decided before the experiment began, that even though it might reduce the chance for our results to achieve statistical significance, it would increase the likelihood that it would benefit the patients if we didn't include a control group. [Ordinarily, control groups are used in most of our studies. Moreover, our EEG sampling, taken prior to any stimulation, provided the control condition, methodologically substituting for a control group.] Nevertheless, because of this decision, this study focuses on comparing the effects of this stimulation to both temporal lobes compared to applying it only to the left prefrontal lobe.

Method

Subjects

This study involved 14 male and female patients, between 25 and 45 years old who suffered from 1) chronic depression 2) beginning after a closed head injury that 3) hadn't responded to antidepressant medications. They were either referred to us by local professionals or they volunteered after seeing a call for participants in a local newspaper. Four of the subjects said that they lost consciousness after hitting their heads. The average time between the brain injuries and the testing was two years. Seven of the patients were randomly assigned to receiving stimulation across the temporal lobes, while another seven were stimulated with the same magnetic signal over the left frontal lobe.

Procedure

The procedure was approved by the university's Human Ethics committee, and the volunteers signed an informed consent document, which made it clear that they could discontinue the treatment at any time. We met with each patient once a week for six weeks, giving them a total of six sessions. Our goal was to produce lasting effects rather than just improvements after each session. For that reason, questionnaires and EEG measurements were done at the beginning of each session, *before* we applied the stimulation. The patients didn't return for measurement and we didn't contact them for six weeks, except to remind them of their appointment for the follow-up session. The final measurements were collected at that time. Each subject was given a brief report on their progress, as shown in EEG data and their answers to the questionnaires.

Each subject completed the *Beck Depression inventory* at the beginning of each weekly meeting, before we applied our magnetic signal and again, six weeks after the final treatment (the follow-up meeting). [Here again, the first answers provided a baseline, control, condition.] Other questionnaires were also used (including one that asked about mild altered state experiences, including déjà vu and sensing a presence called *temporal lobe signs*) three times. 1) Before the first stimulation session. 2), at the end of the six sessions, and 3) once more six weeks after the last treatment session. Three of the subjects who were receiving the left prefrontal treatment didn't return for the

last two or three sessions. [This is probably because weekly sessions stimulating only one side of the brain don't progress as smoothly as those that treat both sides of the brain.]

The EEG readings were done before the first session to establish a baseline, immediately prior to the last session, and once more during the follow-up meeting, six weeks after the final stimulation session. The EEG electrodes were placed over the frontal, temporal and occipital lobes. The magnetic coils, housed in plastic containers, were attached to the head using Velcro while we set up the EEG equipment. We began the magnetic stimulation only after the EEG readings had been taken, [to ensure that the EEG data and the answers to the depression questionnaires related to the week following the session. The same information, gathered immediately after the stimulation, could have been influenced by post-session, short-term effects.]

During the treatment, the patient sat in a comfortable overstuffed chair in a darkened acoustic (completely silent) chamber. The signals were delivered through four magnetic coils over the left frontal lobe or four coils on each side for the temporal lobes, housed in plastic containers. The burst firing magnetic signal was applied once every three seconds for 30 minutes, once a week, for six weeks. It was applied through four magnetic coils, one at a time, so that the magnetic signal was "rotated" through the four coils, once every two seconds. [The rotation was counterclockwise over the right, and clockwise over the left, so that when a coil was active on one side, it's counterpart on the opposite side was also active; in a 'yoked' configuration.]

The records for each of the three EEG channels on each side were later examined, to see which "brain wave" frequencies were strongest ("dominant"). This was done manually, counting the numbers of peaks appearing above the midline of the EEG traces.

We counted the number of seconds each frequency appeared between 9 Hz and 27 Hz, in 1 Hz increments. This was done for each channel (occipital, temporal, and frontal).

We performed multivariate analyses for each of the EEG readings (baseline, after five sessions, and six weeks after the final treatment). We also

analyzed the EEG and data from the depression questionnaires, according to whether the magnetic coils were placed over both temporal lobes or over the left prefrontal region.

To find the strength of each EEG frequency (its “power”) the total number of seconds each frequency appeared was divided by the total number of seconds for each session, for each channel. This calculation also minimized any excessive input into the data from any single subject. We also analyzed this same data according to where the magnetic coils had been placed. All analyses were done using standard statistical analysis software.

Results

We compared the first measures from the Beck Depression scores with the final measures, both for the subjects who received left prefrontal lobe stimulation and those who received stimulation of both temporal lobes. These scores showed no significant difference. However, a comparison of before-and-after measurements showed depression scores were 60% lower after the five treatments. [The questionnaires were given prior to each stimulation session, reflecting changes since the previous one. The final session was not followed by another session a week later, so it wasn’t possible to administer the questionnaire for all six sessions.]

With respect to their temporal lobe signs, we found that the seven patients who received six weekly sessions with the burst-firing magnetic signal showed significantly less frequent *temporal lobe signs* (déjà vu, etc.) than those who received the left frontal lobe stimulation. These group differences were not present before the treatments began. We also found that there was no correlation between the depression scores and how often the temporal lobe signs occurred before and after the experiment.

Interestingly, [and in agreement with the result that stimulating both temporal lobes had approximately the same effect as stimulating only the left prefrontal lobe,] analysis of the various 1 Hz bands of activity in the EEGs of the subjects yielded no statistically significant differences between these two groups.

Looking at the “power measurements” of the frequencies that appeared

on EEG, we noticed significant differences between the baseline, measurements taken six weeks later, and during the follow-up, six weeks after that. These primarily occurred at 13 Hz, 14 Hz, 17 Hz, 18 Hz and 19 Hz.

Analysis after the experiment was completed showed statistically significant increases in activity from the temporal lobes only in the 13 to 14 Hz bands, for both the left prefrontal and (both) temporal lobes, and the measurements taken six weeks after the final session (compared to the baseline). For the patients who received stimulation over both temporal lobes, there were significant differences in the percentages of activity in the 17 to 19 Hz band over the temporal, frontal and occipital lobes. This difference was most apparent for the measurements taken six weeks after the final session. For those who only received stimulation of the left prefrontal lobe, the measures in this range of activity were about the same for the baseline and after six weeks.

We also looked to see if the changes in subject's answers to their questionnaires for temporal lobe signs and the Beck Depression Inventory were associated with the changes in EEG. We did find an increase in the strength of the 18 Hz EEG band, but not the others. [This seems to imply that the stimulation used here made small, but very specific changes in the brain to overcome depression following closed-head injuries.]

Discussion

The results of this study, partly relying on "psychometric" data culled through questionnaires, replicated the results we obtained four years previously. The depressed subjects who experienced the procedure showed a significant reduction in depression by the sixth week of treatment with 30 minute exposures to the magnetic signal. The treatment explained ("accommodated") more than 50% of the changes seen in the answers to the questionnaires. [Note that some changes in the way these questionnaires were answered can be attributed to other changes in the subject's lives. The amount of changes in the way subjects answered questions is not the same as the degree of improvement in depression elicited by the stimulation, especially for the temporal lobe questionnaire.]

We also found that temporal lobe signs happened less often for the

subjects who received stimulation over both temporal lobes following the treatment. Like the scores for the Beck Depression questionnaire (showing a 60% reduction of the symptoms of depression), the effect could still be seen at the end of the study, when they had not received any stimulation for six weeks.

There weren't any significant differences for the depression scores between the patients we stimulated over both temporal lobes and those we stimulated only over the left frontal lobe. However, the temporal lobe signs of those in the "both temporal lobes" group were reduced, and this didn't happen for those in the "left frontal" group.

For humane reasons we decided not to run a control group (applying a sham-field) in this study. Instead, we compared the effects of stimulation over different areas of the brain with the subject's own baseline EEG data. Our working assumption was that if the magnetic fields were most effective over both temporal lobes, the effects should still be evident, measurable, and statistically significant, even when compared with response from the left prefrontal area. Although this approach would reduce the size of the effect (compared to a control group) as clinicians, we felt that the patients receiving the prefrontal application on the left side would at least gain some benefit, and we could use the baseline measurements, taken before any stimulation, as a control condition. This decision was partly in response to the fact that these patients have been treated by doctors and psychiatrists without getting any relief. Many of these patients were going through feelings of futility, which often precede self-destructive behaviors. We took careful note of the fact that three of the patients who had been (randomly) assigned to the "left frontal" group dropped out of the study. This could mean that left frontal stimulation was not effective, or that there were unpleasant side effects. This issue needs more study, [especially to find out whether stimulation of both frontal lobes would be more fulfilling for the patients than only over the left side.]

There were two EEG results worth noticing. The first was that there was a significant increase in the relative strength of the frequencies between 16 and 19 Hz following stimulation of both temporal lobes. This effect did not appear for the subjects who only received stimulation of the left frontal lobe. When we consider that the subjects who received stimulation over both

temporal lobes also saw a reduction in temporal lobe signs (and this was still the case in the final, follow-up, examination) then it's possible that the treatment increased the amount of overall brain activity in the beta and low beta ranges.

The EEG data showed an increase in strength within the 13 to 14 Hz band over the temporal lobes for both groups, so we can't exclude the possibility that some unknown factor may been responsible for the reduction in depression. However, only the group that received stimulation over both temporal lobes showed an increase in strength in the 17 to 19 Hz range, [making it improbable that the changes in the depression scores weren't due to the stimulation]. It's not possible that this was an artifact of the magnetic fields being applied, because the EEGs weren't taken during the stimulation sessions. It's also very unlikely that it was due to entrainment. We analyzed the frequencies of the burst firing pattern, which peaked around 29, 33, and 42 Hz. The peaks in the magnetic signal don't correspond to the peaks in the EEG data. There are small peaks in the burst firing pattern magnetic signal from 14 to 15 Hz as well as from 18 to 19 Hz. It's not impossible that there were changes in groups of neurons that control these specific frequencies reflected in the EEG between the first and the sixth session. Other researchers have shown that 16 Hz, but not 3 Hz or 31 Hz magnetic fields in a specific range of strength, can significantly affect calcium ions in brain tissue. If this assumption is correct, then the treatment may have facilitated learning, which creates permanent changes in behavior.

The schedule for the sessions (once a week) may be a critical factor in the treatment. Applying the stimulation more often might seem like it would make it more effective, but this isn't the case. Another researcher in our laboratory applied the same magnetic signals used in this study with normal volunteers once a day. Compared to the control group, the stimulation reduced scores for depression only when used once a week for 30 minutes at a time, over three weeks. Doing the same procedure once a day was not effective.

The specific shape of the magnetic signal also appears to be essential, just as medications are only effective if they have the right molecular shape. The length of the stimulation and the time between sessions can be compared to

the correct dosage of a drug. It's well-known in pharmacology that one cannot always make a drug more effective just by increasing the dosage. In fact, some drugs, especially those used for depression and anxiety, won't have any effect if the dose is too large. For example, the optimal administration for aspirin, when used as an anticoagulant, may be one dose per week.]

The optimal schedule for applying this magnetic signal can be compared to the same kind of "optimal dosage" we see in psychiatric medications. We can also compare it to the strong differences we see between "cramming for exams" and slow and regular study. [In another metaphor, most musicians find that practicing an hour a day is more effective for developing their skills than practicing seven hours in one day, and neglecting their practice the rest of the week].

The intervals between *electrical* neural stimulations have been shown to have a strong influence on how well the brain "kindles" its response to it. Other researchers have shown that stimulating the amygdala electrically didn't work when the stimulations were 5 or 10 minutes apart, but became effective when the stimulations were 20 and 60 minutes apart.

Our stimulation sessions were 30 minutes long. If there is an ideal length for magnetic field brain stimulation, then there could also be an ideal session schedule to achieve the optimal effects, so that the results reported here could be improved.

CHAPTER SEVENTEEN

Brief Cerebral Applications of Weak, Physiologically-patterned Magnetic Fields Decrease Psychometric Depression and Increase Frontal Beta Activity in Normal Subjects

[A placebo-controlled, blind experiment, which also employed baseline EEG.]

Corradini, P. L., and M. A. Persinger. "Brief Cerebral Applications of Weak, Physiologically-patterned Magnetic Fields Decrease Psychometric Depression and Increase Frontal Beta Activity in Normal Subjects." *Journal of Neurology of Neurophysiology* 4 (2013): 175.

Editor's Note: Some information detailing specifications for the EEG equipment and the computers used to generate the magnetic fields has been omitted, as well as some of the math, as the information is too technical for this simplified rewrite.

Summary:

Background: When applied to the temporal lobes of the brain, 30 minute stimulation sessions, applying a weak magnetic signal (that imitates burst-firing in the amygdala) has been shown to produce analgesic effects in rodents and reduced depression in patients who suffered traumatic brain injuries (TBI). Here we tested psychologically normal volunteers with single sessions of the same neural stimulation to see if the magnetic signal we found most effective in previous studies would reduce depression [with a larger group of subjects], and to measure the effects of this stimulation using *Quantitative* EEG (often called '*queeg'*).

Methods: 22 normal volunteers each received a single 30 minute session with either our burst-firing magnetic signal, or a placebo ("sham") field. [Sham field conditions utilize procedures identical to actual stimulation, except that the cable to the headset is disconnected.] The field was applied so that it ran through the head, encompassing both temporal lobes. Each subject was given a questionnaire called the P*rofile of Mood Scores (*POMS) (short form) before and after the stimulation (or placebo procedure). The subject's neural activity was monitored using EEG during the stimulation or placebo procedure, and then analyzed for correlations between changes in their moods and their brain activity.

Results: The subjects who were given the burst-firing magnetic signal showed a significant reduction in depression scores, compared to those given the placebo procedure. The treatment accommodated about one quarter of the differences. [Note that an earlier study showed a two times stronger effect when stimulation was applied once a week for three weeks than in this study, which compares differences before and after only one session. This study used normal subjects, who were expected to respond less than clinically depressed patients.] As we saw in an earlier study, the *POMS* showed significant differences between stimulation and placebo for depression, but not other moods. The subjects who received the actual stimulation showed significant increases in the strength of their beta waves over the prefrontal area and left temporal/parietal areas. The degree of change in the EEG readings showed a strong match with the amount of change in

depression scores.

Conclusion: Single half-hour brain stimulations using a low power magnetic field embedded with a signal, derived from burst-firing in the human amygdala, produced reliable changes in brain activity that we could measure using EEG imaging. These were also reflected in the POMS questionnaire in normal subjects, [without psychiatric issues]. This technology may be a useful contribution to treatment for patients with traumatic brain injuries, which patients can use for themselves.

Introduction

One of the essential assumptions in modern neurology and the study of brain physiology is that information processing and subjective experiences of any kind happen along with measurable changes in the brain's activity. To change the way we think or feel in clinical practice or the laboratory effectively, we must use agents that can make their way into the brain. Usually, this refers to medications, which the bloodstream can carry into the very small spaces where the brain's synapses operate. Of course, the blood-brain barrier imposes limits on the kind of chemicals we can get into the brain.

An alternative strategy is to apply *magnetic* fields with signals that mirror the brain's own *electrical* firing patterns, just as psychiatric medications imitate the brain's own chemicals. The laws of physics make it impossible for anything in or around the brain to shield it from magnetic fields. [Magnetic fields, no matter how faint, can reach anywhere in the brain, just like psychiatric or seizure-preventing medications.] The last decades of the 20th century saw the appearance of two methods. The first is TMS (Transcranial Magnetic Stimulation). There is strong evidence that its focused magnetic fields, applied over specific areas, can affect the way people think and feel. It works by applying magnetic fields so strong they force neurons (the brain's internal "wires") to burst into activity (through current induction).

A second approach is to use low-power fluctuating magnetic fields (about 1 million times weaker than TMS) that get stronger and weaker every few milliseconds, matching the signals the brain uses in its electrical activity. We've found that applying these magnetic signals between the two temporal lobes of the brain has an effect similar to TMS. Our interpretation for these results is that, when the shape of the magnetic signal matches one of the brain's own electrical activities, the area where the electrical signal originates

will resonate with it. [Thus, an electrical signal taken from the amygdala will effectively activate (or excite) it, when it's applied using a magnetic field.] Brain injuries can leave the brain's tissue particularly responsive to electrical or magnetic stimulation. One of our rat studies showed that, when the brain is in this sensitive state, it's particularly responsive to the therapeutic effects of these magnetic signals, whose [patterns or] shapes repeat the shapes seen in the electrical activity from specific brain structures.

Because the laws of physics dictate that magnetic fields cannot be interrupted, the neural stimulation we work with is intrinsically structured to penetrate through the human head. As an empirical test, we did an experiment where we ran our magnetic signals through various materials with the density and thickness of the human skull. We found the magnetic field strengths weren't diminished [they fell off (with the inverse square of the distance), just as they would with only air between the magnetic coil and a magnetic sensor.]

Earlier, our research group found that stimulating the temporal lobes with the magnetic (amygdala burst firing) signal for 30 minutes, once a week, significantly reduced depression in patients with closed head injuries. The improvement was seen in both the patient's answers to questionnaires and in discussions with patients about improvements in their life skills. The same magnetic signal also had an analgesic effect in rats, comparable to the effects of 4 mg/kg of morphine. [This signal also proved to be a crucial component of the procedure most likely to elicit religious and mystic experiences.]

Humanitarian priorities demand that this technology be explored for clinical use. However, if the effects of this kind of neural stimulation are similar to pharmaceutical treatments, then there may be other similarities as well. We shouldn't be surprised to find that specific "dosages" would be required for optimal effects. We should also expect that the shape of the signals must be precisely correct in order for them to interact with the brain's electrical activity, just as chemical compounds must have precise shapes in order to fit into their receptors (or other targets). In one experiment in our lab, we performed magnetic stimulation sessions for 56 normal (non-psychiatric) subjects, either once a week for three weeks, or once a day for three days, using several different magnetic signals. Each session was 30 minutes long.

Questionnaires to assess the subject's mood were given before and after each session. We found that the burst firing signal produced the greatest decrease in depressed moods (a 50% reduction) in this group. The same signal also significantly reduced depression and phobias in patients with closed head injuries.

The present study was designed to replicate and extend these results using clinically normal subjects and also adding EEG data. [EEG data had been taken in one of our studies with closed head injury patients, but until this study, we had not collected any EEG data from psychologically *normal* individuals in response to stimulation with our burst-firing pattern in this context.]

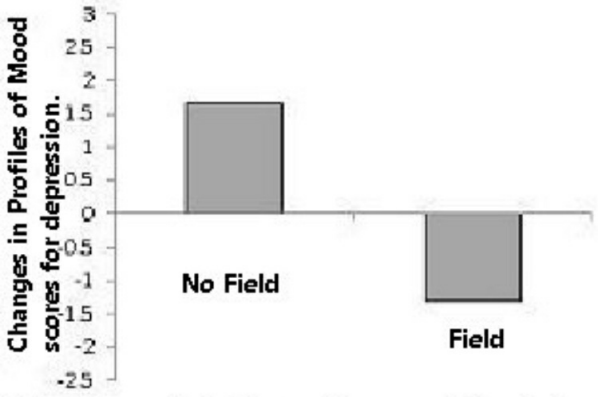
Materials and Methods

This experiment was designed to measure the immediate effects of the magnetic signal on mood and EEG measures. 12 men and 13 women, enrolled in introductory university psychology classes, volunteered as subjects. They were motivated by bonus points toward their final grade in their psychology courses. With the permission of the course instructor, the first author of this paper recruited volunteers among the students using a script, approved by the University ethics committee. Each subject was tested individually. The volunteers signed a consent form saying that they understood they may or may not be exposed to "weak complex magnetic fields". They were assigned randomly either to a magnetic signal or placebo ("sham field") experimental group, without knowing which group they were in [maintaining a "blind" condition]. The volunteers completed the profile of mood states questionnaire before the stimulation began. The *profile of mood states* questionnaire had a list of words that described emotional states and asks people to mark how strongly they felt them over the previous week. It used a scale of 0 to 4. Zero meant they did not feel it at all, and four meant the feeling was extremely strong. It was similar to a "psychometric" questionnaire we used in a previous study. The volunteer sat down in a comfortable chair and was connected to both the EEG equipment and the magnetic coils. The subjects were blindfolded to reduce sensory stimulation.

Eight EEG sensors were placed over the frontal, parietal, temporal, and occipital lobes on both sides of the head. A reference electrode was also placed on the left ear.

Once the subjects were connected to both the EEG and the magnetic coils (connected to our 286 PC computer), we took baseline (control) recordings of their EEG activity, with the subject's eyes closed. After this, the participants were asked to relax (with their eyes closed), for 30 minutes while they were given either a placebo magnetic field (no field) or the actual temporal lobe stimulation. The 30 minute EEG recording was treated as three 10 minute sections, to compare the subject's brain activity as the session proceeded.

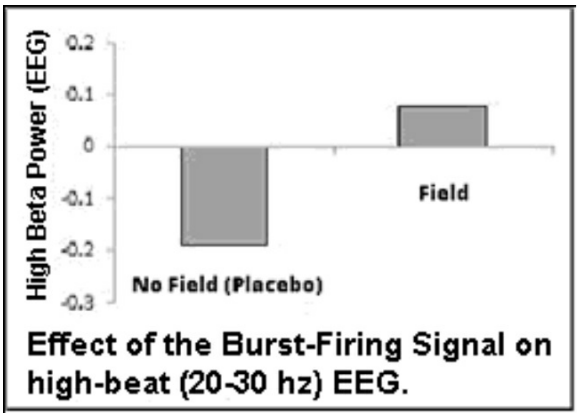
After the 30 minute sessions were complete, the subjects listened to one of three spoken word narratives containing positive, negative, or neutral emotional words. These were each three minutes long, and given by a tape recording, so that all subjects heard exactly the same inflections, vocal stresses and tones of voice. This was done to include some of the effects of therapeutic conversation (verbal tasking) after the treatment, as might happen if it were performed in a clinic. There were no differences in either mood scores or EEG profiles for the different types of narratives, so they were not analyzed further. Another 30 seconds of EEG



The effects of placebo and the actual stimulation on the depression scores on the Profile of Mood States questionnaire.

recording with eyes open, was taken after the subjects had heard the narrative, and a further 30 seconds of EEG was taken with eyes closed. After that, the subjects were disconnected from the EEG and the magnetic signal headset, they went through the *profile of mood states* questionnaire once more, and were then given the opportunity to

share their impressions.



Effect of the Burst-Firing Signal on high-beat (20-30 hz) EEG.

The EEG data (including the baseline recordings, those taken during the experiment, and the data taken after the session) was screened for muscle, and likely magnetic field artifacts. The resulting data was analyzed in seven frequency bands (Using *EEGlab* software). These were: delta (1.5-4 Hz), theta (4-7.5 Hz), low alpha (7.5-10.5 Hz), high alpha (10.5-14 Hz), low beta (14-20 Hz), high beta (20-30 Hz), and gamma (30-40 Hz).

Results

Analyzing the six types of moods covered by the profile of mood scale, we saw that only the depression "subscale" showed an effect. There were no statistically significant changes in the other moods covered in the questionnaire. The results showed a statistically significant decrease (28%) in depression scores for the subjects who received the burst-firing magnetic signal, compared to the group who received the placebo ("sham") procedure.

When the EEG data was analyzed, we found that the subjects who received the actual stimulation had significantly more beta activity (20- 30 Hz) [especially in the frontal lobes] than those who received the placebo. Other frequency bands weren't changed by the treatment.

We looked at the EEG data in the beta frequencies in the first 10 minutes of the sessions, and correlated what we found with the change in depression scores. We saw that there was a decrease in the depression scores, and increased beta activity when the actual stimulation was present. The same changes didn't appear when we applied a placebo instead of the magnetic signal.

Discussion

[Each subject received only one session, resulting in a 28% reduction in depression, as measured by the *profile of mood* scores. However, an earlier experiment, also carried out with clinically normal subjects, three weekly sessions found a 50% reduction in depressed moods. It appears that there's a cumulative effect, and the different score in this study may reflect the fact that it only involved one session. We can compare it to measuring bacterial populations after a single dose of an antibiotic versus the same measure after a full course.]

These results confirm and extend the measurements we found in one of our earlier studies that showed how normal subjects who were given the same magnetic signal had less intense signs of depression, in comparison to several other signals or a placebo. The results make it clear that the shape of the signal is just as important for its effects as the shape of a chemical is in pharmaceutical (drug) treatments. One earlier study also showed that moods were more responsive when the procedure was given once a week [for three weeks], and showed that the subjects had very different responses to different signals. However, that study didn't include EEG readings during the stimulation, [which we used in this one].

The normal subjects [not having psychiatric depression] in this experiment showed a comparable mood improvement. The measurements for the subject's mood improvements correlated with an increase in beta activity, but only for the subjects that had been exposed to the magnetic signal, and not the ones who received the placebo. Looking at EEG readings, we saw that the greatest increases in beta activity were in the prefrontal cortex and the left temporal lobe. It's well-known that activation of the left hemisphere is associated with mood improvements as well as an increase in one's sense of one's self. At the same time, we can expect to see clinical depression and a reduced sense of self when the left hemisphere, particularly the left prefrontal area, shows reduced beta activity.

The procedure in this study was designed to emulate a clinical therapeutic session. Both stimulation and placebo groups listened to the tape recorded narratives after the session. However, only the ones who were given the

actual stimulation showed reduced scores for depressed moods and an increase in beta power in the left hemisphere. We can be sure that the increase in the beta range wasn’t an artifact of the magnetic fields we applied for two reasons. One, because the average frequency from the burst firing signal is outside the beta range, and two, because the degree of increase in the beta range matched the degree of change in mood ratings.

A wide range of medications have been used on patients with traumatic brain injuries for their frequent depression, but there remains a group of them who don’t respond to chemical treatments. In the past, we’ve proposed that this group’s resistance to routine treatments lies in the choice to apply standard antidepressants. These are primarily tested on people whose depression comes from social problems, such as the loss of a loved one, a career or being left alone when the children come of age. When depression follows traumatic brain injuries, the neurons are compromised in very different ways [especially when the impact physically jolts the limbic system], and standard antidepressant medications aren’t effective. Laboratory rats with traumatic brain injuries have been found to have shrunken neurons all through the brain, but especially in the area where the impact occurred. This was found even when the brain injuries to the lab rats were so mild that the rats didn’t even cry out. Exposing these rats to the burst firing magnetic signal reduced the number of damaged neurons, as well as shrinking the area where they were found.

CHAPTER EIGHTEEN

Specific patterns of weak (1 microTesla) transcerebral complex magnetic fields differentially affect depression, fatigue, and confusion in normal volunteers

[A placebo controlled study.]

Tsang, Eric W., Stanley A. Koren, and Michael A. Persinger. "Specific patterns of weak (1 microTesla) transcerebral complex magnetic fields differentially affect depression, fatigue, and confusion in normal volunteers." *Electromagnetic biology and medicine* 28, no. 4 (2009): 365-373.

Summary - A group of 32 psychologically normal young adults, (without clinical depression or other psychiatric disorders), received three 20 minute magnetic neural stimulation sessions once a week. They each received one of seven magnetic signals, with seven different shapes (or “patterns”). A sham field (without signals) was used as a placebo. These signals were rotated through four magnetic coils on each side of the head, placed over the temporal lobes. Before and after each session, the subjects filled out the *Profile of Mood States*, a short questionnaire that asks how a person is feeling in the present moment. We also measured heart rate, skin conductance (which changes as our emotional states change), as well as changes in blood flow (*plethysmography*) before, during, and after each session. The data from these measurements were analyzed using computer software. The results showed that the signal based on burst-firing in the amygdala elicited improved mood and vigor compared to the sham (placebo) field or any of the other signals. The subjects who received either the burst-firing pattern, or one associated with creating memories (in the hippocampus), stimulation using two different signals, (or a very complex stimulation using 50 signals), also showed less fatigue after the

session than those who only received random signals or the placebo (no stimulation). The results here replicate some of our previous studies and show that neural stimulation using correctly designed magnetic signals may mimic treatment with psychiatric medications.

Introduction

Psychiatric medications work because they target specific chemical receptors in the brain, modifying the way specific compounds behave there. We've proposed that magnetic signals, designed to interact with specific electrical activity in the brain, can simulate and enhance the effects of psychiatric medications.

Low strength magnetic fields with complex shapes, coming from the earth's magnetic field and weather systems, have been seen to affect autonomic functions and can influence our moods. In the 1970s, a German researcher reported that pain could be reduced and emotional states could be improved by brief exposures to simple magnetic field pulses, with random frequencies between 1 and 20 Hz. Later, computer technology made it possible to create an unlimited number of complex signals that could, in principle, simulate the many hundreds of psychiatric medications.

We have seen our burst-firing signal reduce pain in rats, as well as permanently reducing psychological pain in human patients who had been through a closed head injury (such as a concussion). Lasting reductions in sensitivity to pain have also been seen in rats with brain damage (from seizures) following 30 minute exposures to this signal, when applied once a week.

The same magnetic signal improved depression in patients who had been through closed head injuries. The stimulation sessions were given once a week, primarily because weekly sessions are common in clinical treatments. We did a follow-up study with normal volunteers receiving three sessions either once a week or three days in a row. We found that weekly sessions produced significant decreases in signs of depression, measured using psychological questionnaires. Daily sessions didn't have this effect.

This study was designed to answer specific questions that would come up before expensive and time-consuming clinical trials. We had three main questions. 1) Are there other magnetic signals that can have the same antidepressant effect as our burst-firing pattern? 2) Would we also see the kind of physiological changes that appear when depression is reduced? 3) Are there any adverse effects, especially when the magnetic signals approach the 20 millisecond interval associated with human consciousness (“the binding factor”)?

To answer these questions, we measured heart rate, galvanic skin response (which changes as our emotions change) and blood flow (through the left thumb), before, during and after each stimulation session. Most importantly, we administered the *profile of mood states* questionnaire to see mood changes before and after each session. [The answers to the questionnaire before the first session served as a baseline, or control condition.] This questionnaire included items to measure confusion, fatigue, vigor, anger, depression and tension. The session itself consisted of either one of seven different magnetic signals, or a placebo (“sham”) magnetic field. We reasoned that if the effects from any of the signals were strong enough to be used in clinics, we should be able to see the difference with only four subjects per group. Effect sizes of about 50% would be enough to show any potential for clinical use.

Method

Subjects

16 men and 16 women, students enrolled in university courses (totaling 32 subjects), aged between 20 and 25 years old, volunteered as subjects. They were remunerated either with a small payment or bonus marks for university courses.

Procedure

Each subject was tested individually. They signed a consent form that told them they may or may not be exposed to low intensity “complex magnetic fields,” and that they would need to return for three sessions. They were put into the eight experimental groups at random. Their sessions were done once a week between noon and 7 PM in the summer of 2001.

Before each session, the profile for their mood states was taken using the questionnaire. The subjects were blindfolded and given ear covers that reduced the background sound to below 30 dB. We used a slight variation of our helmet for this experiment. Its same magnetic coils were housed in square plastic containers and arranged so that the signals rotated from one coil to the next. [Like the God Helmet,] these were placed over the temporal lobes (just above the ears). The magnetic coils on each side of the head produced their fields at the same time, "yoked" to their counterparts on the opposite side. This directed the magnetic fields through the head, and not just into the surface of the temporal lobes. [This is important because the burst-firing signal is derived from the amygdala, a structure deep in the brain. Superficial stimulation of only the brain's surface might not have produced same effects.]

The signals are plotted to a column of numbers (with each number corresponding to a specific voltage) and fed to a digital to analog converter that produced the electrical currents indicated by the numbers. The currents are fed to magnetic coils, which converted them to magnetic fields. The fields fluctuated, getting stronger and weaker, as the computer read through the column of numbers. The output was cycled through the four magnetic coils on each side of the head, in most cases "rotating" them through one cycle (with each coil active for the same length of time) every two seconds.

We compared seven different magnetic signals, as well as placebo ("sham") stimulation. We made sure to include the burst-firing pattern because of its success in reducing two kinds of pain in laboratory rats (from heat and electric shock), as well as depression in clinical patients. We used a neural pattern [a "hippocampal" signal] associated with memory creation (long-term potentiation) in the laboratory. It was the basis for two of the signals we tested in this study. We also tested a sequence of 20 minutes burst firing, followed by 10 minutes of this "hippocampal" signal. We included the signal because of its impact on memory in both humans and rats. We also used the hippocampal signal, repeatedly applied every 20 milliseconds, so we could compare it to other studies we've done where we moved the signal around the head ("circumcerebral" stimulation) through eight pairs of magnetic coils, changing position approximately every 20 ms.

The most complicated stimulation consisted of 50 different signals that had each been shown to be effective in earlier experiments. These were interspersed by instances of the “hippocampal” signal. Each signal was presented for 30 seconds. This was followed by three seconds with no stimulation. Interestingly, the complicated structure of the stimulation, with its 50 different magnetic signals, was developed to affect gene expression in developing rats. We found this pattern produced significant mood improvements in three patients who had sustained serious head injuries and had been undergoing chronic depression, leaving them unable to work for years. We also slowed down the rotation, because the signals were longer than the ones we usually use.

[The signals are typically about three quarters of a second long. There’s a gap of three or four seconds between each ‘run’ of the signal, though some of the signals used in this study had much shorter intervals.]

Finally we used a sequence from a random number generator, to see any differences between the effects of the complex structure of our signals and simple random numbers. These different combinations would allow us to see if the 1) duration of the signal, 2) its specific pattern 3) the intervals between applying the signals, or 4) the length of each point (or pixel) in the signal were responsible for any specific effects.

We took the average values for heart rate, skin conduction (galvanic skin response) for each session and each subject. We also measured blood flow through the left thumb. We did this for two minutes before each session to establish a baseline for that session, and during the first and last three minutes of the actual stimulation.

The galvanic skin response test gave us a digital display showing the startle response (in comparison to relaxation).

We used a heart rate monitor, commonly used to monitor athletic performance. It used a radio transmitter, worn around the chest and held in place with an elastic strip.

To minimize individual differences, we used the ratios of the three measures and divided them by the baseline values. For the psychometric test

(the *profile of mood* questionnaire) the average scores for each of the emotions in the questionnaire were divided by the scores for each session. [The procedures and mathematical techniques are more fully described in the original paper than in this simplified version.]

Results

There were statistically significant differences (that could be attributed to the magnetic signal stimulation), between the seven treatment groups before and after all three weekly sessions for depression (reduced by 50%), fatigue (reduced by 52%), tension (reduced by 53%), and confusion (reduced by 48%). Other items on the *profile of mood* questionnaire did not show statistically significant differences before and after the treatment. When compared to the placebo ("sham field") group, the largest single difference was the reduction in depression scores. The hippocampal signal did not produce any reduction in depression.

With respect to fatigue, we obtained the strongest results from the subjects who received the burst-firing pattern, the hippocampal pattern, or the complex stimulation that used 50 multiple signals. They reported significantly less fatigue than the groups that had been exposed to a variation on the hippocampal signal, the placebo condition, the random pattern, or the group that had received the hippocampal signal (with the time between repetitions reduced from three seconds to 20 ms). 20 minutes of this signal also generated increased confusion, compared to any of the other groups. The physiological measurements, heart rate, galvanic skin response or blood flow were not changed [indicating that there were no adverse physiological effects.]

Discussion

Another kind of magnetic stimulation, Transcranial Magnetic Stimulation (TMS) uses very intense magnetic fields with simple unchanging pulses. In contrast, our method uses weak magnetic fields, with complex signals (fluctuations in field strength) embedded in them. In earlier studies, we found that applying our faint magnetic signals through both temporal lobes created significant reductions in depression in victims of closed head injuries. It was approximately as effective as TMS, even though TMS uses magnetic fields

approximately 1,000,000 (one million) times stronger.

Another of our studies showed that improvements in depression were higher when the treatments were given once a week for three weeks instead of once a day for three days. [These magnetic fields have to be administered on schedule, just as medications must be taken on time to be effective.] Measures of depression were more significantly more reduced for subjects who were given the same signal (burst-firing signal, repeated once every three seconds) that had previously been effective for depressed patients. However, we also found that stimulation using a random series of frequencies, changing once every three seconds, also produced a lesser, but still significant, reduction in depression measures in these normal volunteers.

These results suggest that the burst-firing magnetic signal, presented once every three seconds may be effective for treating depression. One of our colleagues found that the effects of this signal, when it's presented once every four seconds, could also be created using a "chaotic" magnetic field pattern, changing the signal every three seconds. The burst-firing signal also produced analgesic effects in rats. However, another signal (a frequency-modulated "chirp" signal) did not produce any analgesic effects. Our hypothesis is that specific signals, presented with the right timings, only produce specific effects when they're applied with the right interval between them (like chemical medications given on a certain schedule). In the present study, the hippocampal pattern, presented once every four seconds, did not create any changes in psychometric depression. [This is a significant result, because it makes it clear that different magnetic signals have different effects, even when presented in the same experimental context. The fact that the effect depended on which signal was used rules out suggestibility or suggestion as an explanation for our results. If the effects were due to suggestion, the results would have been the same for all signals.]

The subjects who were given either 1) the burst-firing pattern presented once every three seconds, 3) the complex pattern, 2) or the hippocampal signal once every three seconds showed less fatigue from sitting in the experimental room, compared to the other subjects who were given other signals. We should also note that one of the stimulations used both the hippocampal and the burst-firing signals. The variations on the hippocampal

signal each had different effects, showing that the information they contain is more likely to have been responsible for their effects than the strength of the magnetic carrier.

[Because the binding factor for consciousness appears to refresh every 20–25 milliseconds,] the increased confusion score for the subjects who were exposed to the hippocampal signal with only 20 ms between each repetition may be an interesting observation for the study of consciousness.

TMS, which has produced significant improvements in diagnosed clinical depression, also had only lesser effects on the moods of normal volunteers. TMS uses pulsed fields that are much more intense and appear to rely on current induction, where intense magnetic fields, so strong that they can even force the scalp muscles to contract, directly elicit electric currents in neurons. The primary mood changes from TMS have been positive and show a reduction in anxiety.

The effect sizes for the treatments in this experiment (with normal subjects) were within the mild to moderate range. We saw larger effects with psychiatric patients who had clinical depression using the burst-firing signal. Nevertheless, the observations here should not be trivialized. The margin of error for the *profile of mood* scores in normal subjects is small. More importantly, people with psychiatric disorders, even those too mild for them to seek out treatment, should respond to the treatment more readily than clinically normal people.

In other works, we've called this the "aspirin effect." Aspirin won't do anything if you take it when you don't have any pains or inflammation. On the other hand, if you have a headache, aspirin can make a large change in your well-being. It can lower body temperature in people with fevers, but not for people with normal body temperatures. Similarly, normal subjects can be expected to show a lower mood response to our magnetic signal stimulation than those with clinical depression, just as we see with TMS.

Mood enhancements can occur during stimulation sessions with our burst-firing signal, and the association between this elevated mood with the setting and personnel might tend to reinforce a patient's positive experiences, and this could help patients comply with the treatment.

CHAPTER NINETEEN

Changes in emotional and autonomic responses with complex magnetic signals: daily versus weekly schedule.

E. W. **Tsang**, M.A. Persinger, S.A. Koren, "Alterations of affective and autonomic responses with transcerebral complex magnetic fields: daily versus weekly schedule" 2002

[Placebo controlled]

Editor's Note: This unpublished study reports two experiments. Placebo controls were used in both. It used a questionnaire that measured the subject's depression, which tended to inform the subjects of the purpose of the study, so that blind conditions were not possible. This study's value was primarily demonstrating that weekly sessions were more effective. Other unpublished observations showed that 1) other schedules were not effective and 2) although sessions every 72 hours were unlikely to have any cumulative effects, they did not elicit any negative ones.

Summary: Two experiments are reported in this paper. They investigated changes in emotion and autonomic function using two different schedules for the magnetic signal neural stimulation. In the first experiment, 24 student volunteers were given the stimulation with either a placebo stimulation or one of two magnetic signals; a "burst firing" pattern, or the same burst signal, followed by a theta pulse. [These are brief signals, with a silent period (latency) between each "run" of the signal] They were given three stimulation sessions, each 20 minutes long, either for three days in a row, or once a week for three weeks. The signals were applied to the area between the frontal and temporal lobes, on both sides of the head. A psychological questionnaire (the *Profile of Mood States*) was given before and after each stimulation session. We also measured autonomic functions, which included skin conduction and heart rate, as well as changes in blood flow (*photoplethysmography*). These measurements were taken before, during, and after each stimulation session. The results from this experiment showed that the weekly stimulation schedule was more effective than daily stimulation both for creating autonomic changes and improving emotional states.

The second experiment used 32 psychologically normal students as subjects, and one of seven different magnetic signals (or a

placebo). The procedure in this second experiment was the same as that in the first, except that all the subjects were given three sessions, once a week. The results of the second experiment demonstrated that the signal derived from burst firing in the amygdala was the most effective.

Introduction

A study we carried out in 1996 involved stimulating both temporal lobes with a magnetic signal shaped like neuronal burst firing in the amygdala. We found it could lower long-term clinical depression [and reduce phobias] in patients who had been through closed-head brain injuries. In that experiment, we applied the stimulation once a week for 30 minutes over five weeks. We found that all the patients showed a reduction in depression (averaging 67%), which we measured using *the Beck Depression Inventory*, a well-known questionnaire for measuring depression. The most obvious reduction of the depression scores was seen after the third weekly session.

The experiments reported here were designed to see if the results of this earlier experiment would also appear with healthy, normal student subjects. In the first experiment, we used 20 minute sessions with the subjects to compare two different signals as well as two different schedules for applying them.

One of the schedules called for stimulation once a week and the other involved applying it once per day. The second experiment also applied the 20 minute stimulation, once a week for three weeks, so that we could compare seven different magnetic signals. We also wanted to know if different signals would have different effects on emotional and physiological states and responses.

Method

Subjects

The first experiment involved 12 male and 12 female student volunteers between 20 and 25 years old. We randomly assigned each of them to one of three stimulation groups:

1) 20 minutes of burst firing or:
2) 10 minutes of burst firing
   2a) followed by 10 minutes with signals in the Theta range, or:
3) 20 minutes of placebo stimulation.

[The signals are brief. Each instance is less than a second long. They “loop” or “play,” including three or four second “gaps” with no field repeating for the length of the session.] Half of the subjects were given the stimulation once a day for three days in a row, and the other half were treated once a week for three weeks.

The subjects participating in the second experiment, which used 32 male and female volunteers, were randomly placed in one of the seven groups, as follows:

1) 20 minutes of the burst firing pattern.
2) 10 minutes using the burst firing pattern, followed by 10 minutes of a Theta range pulse.
3) 20 minutes of the theta pulse with four seconds between each instance of the signal.
4) 20 minutes of the theta pulse with 20 milliseconds between each instance of the signal.
5) 20 minutes of a random signal with one millisecond between each instance of the signal.
6) 20 minutes of the random signal with three seconds between each instance.
7) 20 minutes of placebo stimulation.

[For the second experiment, we only report the most effective two of them.]

Procedure

The subjects were tested one at a time for all stimulation sessions in both experiments. They sat in a comfortable chair during the procedure. They were also given a blindfold and ear covers to create a limited sensory deprivation. Their autonomic responses, including heartbeat, galvanic skin response and blood flow, were recorded before the stimulation session, while it was in progress, and again afterwards. The *Profile of Mood States* questionnaire was taken before the stimulation began. After taking this psychometric test, a pair of headphones embedded with four pairs of magnetic coils was placed over the subject’s left and right temporal and frontal areas. The magnetic signals passed through these areas on both sides of the head. They were delivered by the four pairs of coils (four coils on each side, over four different but adjacent areas) for 20 minutes. The subjects who were randomly placed in the placebo group were not exposed to any magnetic signals. The subjects took *The*

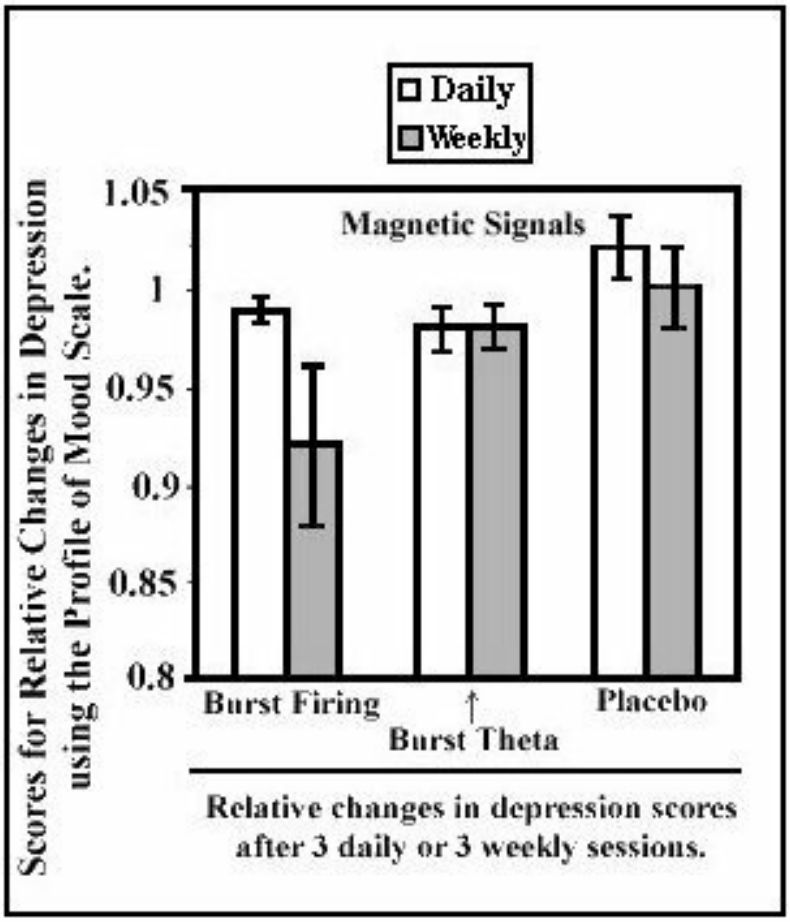
Profile of Mood States questionnaire for a second time about five minutes after the sessions were done.

Results

We calculated the overall scores from the Profile of Mood States and the physiological measures by dividing the scores taken after the stimulation sessions by the scores taken before the session. The results from the first experiment showed that the group that was given the burst firing signal showed lower heart rates (about 28%) than those in the other groups during the first session.

In the first experiment, the group who received the burst firing pattern once a week had lower scores for depression (44%) and a greater *reduction* in depression compared to the other groups after three weekly sessions, and this demonstrated that weekly sessions were more effective than daily sessions.

The results of the second experiment, comparing six signals and a placebo, showed that the amygdala burst firing signal was the most effective for reducing depression (50%) after three weeks of treatment. After the three weekly sessions, the subjects who were given the theta pulse, once every four seconds, had lower scores for fatigue (53%) and confusion (34%) than those who were given either the placebo or the theta pulse, with 20 milliseconds between each “loop”. [There was a small reduction in depression for the placebo group in weekly sessions, which may be attributable to the sensory deprivation used in the placebo condition.]



Discussion

This study was the first to show evidence that these low intensity magnetic signals changed physiological responses in people. It also showed that the signal based on burst firing in the amygdala lowered depression in normal subjects; something we had previously seen in brain injured patients. Another result was that the pulsed theta signal had an opposite effect when it was applied with different interval between each instance or “loop” of the signal. This result is consistent with the results of previous experiments with humans and rats on the influence of this theta pulse on verbal and spatial learning.

To summarize, our magnetic signals tend to create positive effects with our subjects when the interval between pulses was around four seconds. However, more negative effects appeared when this interval was shorter (either 20 milliseconds or 1 millisecond). This suggests that these magnetic signals enhance specific brain activities, as differences in the intervals

between the signals determined the effects.

CHAPTER TWENTY

Facilitating the sensed presence with low-intensity magnetic signals in the lab depends on the specific signals used, not the suggestibility of the subjects: a re-analyses of 19 sensed presence experiments.

Pierre, L.S. and Persinger, M.A., 2006. "Experimental facilitation of the sensed presence is predicted by the specific patterns of the applied magnetic fields, not by suggestibility: re-analyses of 19 experiments." *International Journal of Neuroscience*, 116(19), pp.1079-1096.

Editor's note: This paper is largely about methodology, discussing what correlates (or doesn't correlate) with the sensation of a presence in our experiments, and the personality traits of the subjects.

It was produced in response to a heavily flawed experiment performed at Uppsala University, which was unable to elicit the effects Dr. Persinger reported from his experiments. Although Persinger had provided the hardware and software, the Uppsala researchers did not follow the instructions for using them. The software was designed for DOS, but The Uppsala group (led by P. Granqvist) ran their signals under Windows 95, which distorted the output. The signals no longer had the same shape, preventing them from producing the effects Dr. Persinger had explored. Instead of contacting Dr. Persinger for tech support, the Uppsala group decided to explain their failure as due to Persinger's research methods. They speculated that Dr. Persinger's effects could be explained as reflecting suggestibility, spiritual beliefs and temporal lobe sensitivity in the research subjects. They also claimed that Persinger's work didn't use placebo controls and blind conditions. As you can see from this book, Persinger's research group did, in fact, use placebo controls (referred to as "sham" stimulation), as well as blind and double-blind conditions. The claim that Dr. Persinger

didn’t use proper experimental methods has no basis in fact.

When they first approached Dr. Persinger about their research project, they said their experiment would be limited to PET scans of their subjects while receiving the magnetic signal stimulation. The effects of this technology can be seen through brain imaging using shorter stimulation sessions than we need to produce the sense of a presence. Nevertheless, they changed their research goals, and instead decided to pursue the sensed presence experience, without informing Dr. Persinger, so he had no opportunity to tell them how to change their experimental procedure to do it. The Uppsala group used 10 minute stimulations, enough to make effects that will appear on PET scan, but not enough to elicit the sense of a presence.

There are some kinds of experiments where blind procedures can’t be used. For example, suppose you wanted to do an experiment to see if meditation can reduce pain. To observe double-blind conditions, you would have to make sure that the subjects didn’t know what the experiment was designed to prove. However, the fact that they were asked to meditate would reveal part of the study’s intention. Further, the fact that they were experiencing pain, and weren’t dismissed from participation because of it could further “tip them off” about the experiment. You couldn’t introduce a placebo control because there is no such thing as “fake” meditation to substitute for the real thing, the way a sugar pill substitutes for an actual medication in a drug trial. Nevertheless, this doesn’t mean that such studies dispense with scientific method altogether. You could, for example, compare the long-term effects of meditation for reducing pain to the long-term effects of a pain medication, like acetaminophen. Instead of trying to conceal the fact that meditation played a role from the subjects in such a study, you could compare it to other cognitive tasks, like reading silently or playing video games, which don’t relieve pain. Even here, the subjects who spent time reading silently would know that it was part of the experiment. The placebo-controlled, double-blind protocol was designed for testing drugs, and it isn’t as elegant when it’s used to study human behavior,

which often can’t be reduced to procedures.]

Summary:

If brain activity creates all of our subjective experiences, then it should be possible to elicit specific experiences, including those of God or spirits, using the right kind of brain stimulation. Over the last 15 years, our experiments have demonstrated that the sensation of a presence of a “sentient being” can be consistently invoked by passing specific magnetic signals embedded in weak magnetic fields through one or both temporal lobes. Recently, a Swedish researcher, Pehr Granqvist and his colleagues, attempted to explain these effects by attributing them to suggestibility and certain spiritual beliefs, following their failure to elicit the phenomena using our equipment. In response, we re-analyzed 19 of our experiments that explored the “sensed presence”, involving 407 subjects. This analysis showed that the specific signals we used were responsible for the sensed presence effect, and not the subject’s spiritual beliefs, prior experiences of the presence, or their suggestibility. We have seen that the subject’s histories of sensed presence experiences, before they participated in our experiments, were moderately correlated with their beliefs, as well as their temporal lobe sensitivity (“lability”). Several of our more recent experiments showed that whether the presence appears on a subject’s left or right side can differ according to the shape of the magnetic signal, and which side of the brain receives a stronger field. We also emphasize the importance of the signals’ accuracy, both in their component frequencies and their fluctuating amplitudes, as well as the procedures for applying them correctly.

Introduction

The sensed presence experience refers to episodes when people feel that someone or some kind of conscious entity is close to them, but when they look around, they find no one there. Throughout history, people have explained this sensation as visits from actual gods, spirits, and muses. We’ve found that very creative people have it more often than others, and they tend to believe the entity is “real”. So do people with seizures that start in the deep areas of the temporal lobes. Patients who’ve been through “mild” brain injuries also have the sensed presence experience more often than usual. So

do religious believers. Here we mean both people who have strong private beliefs, either in the gods of their cultures, such as God the Father, or Allah, or with more “exotic” conceptions, such as a “universal intelligence,” a “supreme being,” or a “cosmic consciousness.”

If we want to understand the neural mechanisms and processes that support spiritual phenomena using scientific methods, we must work with them in laboratory experiments. If all of our experiences are created in the brain, then our perceptions of other beings, including real people, apparitions, and God, will also be generated [or reflected] by its activity. We’ve worked with several hundred volunteers over the last 15 years (prior to 2006), and we’ve collected substantial psychological, neurological and EEG data from these subjects. Our work has also involved applying specific signals, embedded in weak magnetic fields, through the temporal and parietal lobes of the brain, to produce the sense of a presence. The specific shapes of these signals were designed in imitation of natural brain activity.

We’re not the only researchers who’ve explored the idea that the human sense of self depends on the complicated and subtle electrical, vascular, and structural differences between the two sides of the brain. The same idea also applies to our sense of “the other” [primarily other people, but also illusory beings we feel we can interact with, such as deities, “invisible friends”, and “spirit guides”]. This concept leads us to the idea that the sense of self has strong ties to our language processes. The sense of a presence and our sense of “the other” are based on temporary intrusions of the right hemispheric (and therefore less verbal) “self”, into the one on the left, so the normal sense of self can become aware of it, [and can, to some degree, ‘talk’ to it]. Any event that disrupts the normal controls each hemisphere exerts over the other, even for a few milliseconds, can make the sensed presence more likely.

We’ve seen that stimulating the right hemisphere of the brain with one signal (a “chirp” signal), followed by stimulation of both sides with another signal (the “burst firing” signal) is the most effective procedure for eliciting the sensed presence and apparitions. One of our findings has been that using slightly stronger fields in the first phase tends to create more communication between the hemispheres than they usually have [which contributes to the effects of the second phase of these sessions]. This extra left/right

communication is routed through the corpus callosum (the largest structure connecting the hemispheres). There are also two other structures, 1) the anterior commissure, which connect the two amygdala and temporal lobes to each other, and 2) the dorsal hippocampal commissure, which connects the two hippocampuses to each other. We've also seen evidence that the right hemisphere, or one of its components, responds to both low intensity magnetic fields, and higher levels of activity in the earth's magnetic field.

Although magnetic fields can induce electrical currents (both in neurons and ordinary copper wire), we have worked with low intensity fields with the idea that the information embedded in the weak magnetic fields we use, as well as their overall complexity, is imposed on the magnetic fields at work in the brain. In this "language," what a sentence says is more important than how loudly it's spoken. The brain's response to this kind of complexity implies that some of its functions may rely on information encoded in its own low intensity magnetic fields. Other researchers have suggested the same thing, and some of them have obtained neural responses from very low (picotesla range) magnetic field stimulation through different method-ologies than we've been investigating.

Magnetic simulations of the electrical activity in the brain can elicit "paroxysmal" EEG responses (similar to seizural activity), along with the experience of a "powerful presence". The strengths of these magnetic fields are about 10 mG in the center of the brain, [and about 10 times stronger when measured directly from the magnetic coil]. We calculate that they are still strong enough to influence the amygdala and hippocampus, deep in the limbic system. The mechanism is not current induction [where magnetic activity generates electrical current], but rather sympathetic resonance, where the brain starts to produce electrical activity with the same information as the one delivered by the magnetic signal ("entrainment"). These signals can entrain EEG activity, and they can even change the amount of alpha rhythm in the subject's EEGs when they're applied to just one side of the brain.

With 30 minute exposures, the most effective signal for invoking the sensed presence has also created analgesic responses in rats (among other effects) [lab rats are not subject to placebo effects or suggestion]. These results suggest that our magnetic signals can influence some very

complicated brain activities, and even influence consciousness itself [not shutting it off, but rather eliciting states of consciousness].

In 2005, the Uppsala group reported that they didn't see a significant difference between stimulation with the magnetic signals that were supposed to duplicate our procedures, and their placebo group. They concluded that the magnetic signals didn't have any effects, and that their subject's responses were due to suggestibility, temporal lobe sensitivity, "new age" lifestyles and beliefs. [We'll look at each of these claims in the course of this paper.]

Suggestibility

We've conducted some of our experiments using the *Hypnosis Induction Profile* allowing us to quantify the subject's suggestibility, and many more experiments involved gathering data to measure the subject's temporal lobe sensitivity (using the *Roberts Inventory of Temporal Lobe Signs*) directly. We also used questionnaires that allowed us to see the subject's involvement with new age ideas (using the *Personal Philosophy Inventory*). We've also studied the effects of subtle suggestions and hypnotizability on the results of our experiments. [The Uppsala researchers claimed that we didn't control for suggestion.] In 19 our sensed presence experiments, the subjects never knew whether the fields were being applied or not. In these same experiments, the experimenters (14 female and 5 male) who actually interacted with the subjects didn't know what hypothesis was being tested or whether subject received a magnetic signal or a placebo. In about half of our sensed presence experiments, the subjects were either given 1) only one out of the several different signals we used, or 2) a placebo. The experimenters who spoke with the subjects also didn't know which signal was expected to be most effective [or the purpose of the experiment.]

The results from the Uppsala study, from both their distorted stimulation and their placebo group, were about the same as the results from our placebo control subjects. We've found a minimum of 10% and a maximum of 30% of our subjects reported the sensed presence at least once in a placebo condition in our acoustically silent chamber. This number partly depended on the exact experimental conditions, and whether the placebo was a magnetic field with no signal or no field at all. [It also depended on the degree of sensory

deprivation and whether the subjects received their stimulation between midnight and 4 AM, when melatonin levels are at their highest]. In contrast, when we applied the actual (burst-firing) magnetic signal, we found that 80% reported feeling the sense of a presence.

Temporal Lobe Sensitivity

It's very unlikely that there are any differences in temporal lobe sensitivity between Swedish and Canadian students. The scores from the two different student populations are about the same. In addition, the scores were also similar among students in a Bangkok University, after the questionnaire (*The Personal Philosophy Inventory*) was translated into Thai.

Stimulation Procedures and a Re-analysis of Our Data

We returned to our original data and re-analyzed 19 of our experiments involving 407 subjects (age 17 to 55, with the average age being 20 years old) to see where the discrepancy between our results and those from the Uppsala researchers may have come from. In most cases, the subjects volunteered in exchange for two bonus points towards their final grade in a first year university psychology class. Most of them were told that they were involved in a relaxation experiment, though some were told they were participating in memory research. All the subjects had completed two questionnaires, the *Personal Philosophy Inventory*, and a questionnaire that measured their "temporal lobe sensitivity" or how prone they were to "temporal lobe signs". This was done months before their God helmet session. Some groups of questions asked about their personal history of sensing a presence, the feeling that some kinds of words (like scripture, lyrics, or poetry) were intensely meaningful, their religious convictions, as well as otherworldly beliefs that didn't come from specific religions (including, for example, believing that UFOs are alien spaceships).

The subjects were randomly assigned to stimulation or placebo groups, and were scheduled to participate in sequence, so that the subjects receiving the placebo were mixed with those who received the actual stimulation. The "sensed presence" theme was never mentioned to them, except in the experiments that looked at whether the presence appeared on the left or the right (below). These experiments covered a wide range of phenomena,

including memory, auditory experiences, creativity, a few gender differences, and visual illusions. [There was no single experiment dedicated only to eliciting visions of God.] We never tested more than two subjects in one day. Each of them sat in a comfortable chair, facing east, kept in a completely silent, absolutely dark, small room, which measured 2.74m x 2.54m x 1.98m (9 feet L. X 8.3 feet W. x 6.5 feet H.). The subjects were also blindfolded, because this made the sensed presence experience a bit more likely.

We told our subjects that any experiences during the stimulation would be subtle [eliminating any expectation of a powerful experience so these would appear unexpectedly], and that they should not try to think of how they would describe anything they felt, but rather just to experience it. In most cases, they were given the option to report any sensations or experiences verbally, through a microphone attached to their clothing, and connected to a tape recorder, or they could just stay silent, and make their comments afterward. Every subject wore a modified helmet, equipped with magnetic coils, whether they received actual stimulation or a placebo. The blindfold was taken off at the end of the session. The subject stayed in the chair as they were given a questionnaire, immediately after their session was finished. One side of the questionnaire asked about experiences we had seen from the stimulation in our early experiments (with 60 subjects), such as “I sensed a presence”, with three simple ways of answering. They were “never”, “once”, and “several times”. The other side of the questionnaire asked if they had certain specific experiences, such as visual phenomena, a feeling of meaningfulness (as though the experiences were important to them personally), headaches, etc., on a simple yes/no basis.

In about half of these experiments (with more than 250 volunteer subjects), we also took EEG readings from the left and right frontal, temporal and occipital lobes. Typically, when we saw more (EEG) alpha activity from the temporal lobes than the occipital lobes, we also received reports of sensed presences along with intense emotions. These powerful emotional responses depended on which signal was given, and they were most likely when the burst firing signal (derived from bursts of activity in the amygdala) was applied over both temporal lobes [especially when preceded by the “chirp” signal only over the right side. The amygdala is a very emotional structure].

The amount of alpha rhythms per second in the temporal lobes had a moderate and positive correlation (50 to 60%) with both the number of sensed presence reports and the specific magnetic signals we applied. There have also been reliable but moderate correlations (40 to 60%) between 1) above average levels of geomagnetic activity, 2) the sense of a presence, and 3) illusory feelings of movement ("vestibular" experiences) that often emerge shortly before the presence appears. Temporal lobe sensitivity had a moderate, positive correlation (30 to 49%) with scores for hypnotizability.

The magnetic signals that passed through the subject's brain, delivered by the helmet's four magnetic coils on each side, originated from a computer-driven digital to analog converter, located outside the chamber. The signals were "rotated" around the periphery of the temporal lobes (with its approximately elliptical shape) using a sequencer. The signal was encoded in a column of numbers, and the polarity and field strength of each pixel was represented by a single number in this column. The magnetic field strength in the center of the brain was about 10 milligauss [and was about 10 times higher when measured directly from the magnetic coil].

We had two ways of creating the placebo ("sham") condition. The one we used most involved using identical procedures, including loading the specific signal to the computer, but without activating it. In this placebo condition, about 15% of our placebo subjects reported the sense of a presence, in response to a yes / no question. [This reduced the effect size, but allowed us to make sure that the effects were from the signals, and not the fields.] Another way was to leave the computer in a resting state ("standby" mode), with all circuits connecting the helmet to the computer turned off so there were no magnetic fields at all. This would elicit reports of a sensed presence from 6% of our subjects, also in response to a yes or no question. The first of these generated a 1 to 4 mG magnetic field over the right hemisphere when only that side was active. This "blank field" could then be compared to no field at all, or to the magnetic fields carrying our signals. Both conditions offered reliable placebo controls, as we were primarily testing the effects of our magnetic signals, not the magnetic field that carried them.

The Sense of a Presence Appearing in Our Experiments vs. the Subject's Personal History of the Sensed Presence. Controlling for Private Beliefs

and the Individual's Temporal Lobe Lability ("Sensitivity")

All the 201 subjects that were given the most effective magnetic signals [in the right sequence] for producing the sensed presence, as well as to the placebo stimulation, were compared to the subjects who'd been given different signals that we knew wouldn't create the sense of a presence. We re-analyzed this data to see if either the subject's beliefs or their temporal lobe sensitivity would predict the outcome, as the Swedish research group claimed. [The signals that do not elicit a presence still didn't do so when applied to individuals with large numbers of spiritual beliefs and more sensitive temporal lobes.]

Two of these experiments, carried out by two different experimenters, used the ideal signals. All of the subjects (75) went through the post-session questionnaire after being given 30 minutes of the signal derived from burst-firing in the amygdala, or the placebo (with the equipment running, but without generating any magnetic signals). The number of times subjects reported a presence (either "never," "once," or "several times") was divided by the average score for all 20 questions on the questionnaire in order to prevent errors arising from any subject's mis-reporting unspecified odd experiences as the sense of a presence.

Statistical analysis of the results showed that the sense of a presence was significantly more frequent, both for reports from individual subjects, and in the averages for all of them (compared to the placebo group). [Please refer to the original paper to see the statistical results.] There were no statistically significant differences between the sensed presence scores during the stimulation from people with 1) higher than normal temporal lobe sensitivity, 2) traditional religious beliefs, 3) new age ideas, or 4) their previous experiences with spontaneous sensations of a presence, and those without these traits. There was also no significant correlation between any of these measures and the chances of them reporting a sensed presence in the placebo condition. [When they were given the placebo, subjects who had these traits were just as likely to report few or no moments when they sensed a presence as the subjects who didn't have them.]

There was no correlation between 1) past history of sensed presence with

reports of the sensation of a presence during the stimulation sessions and 2) the subject's answers to questions that controlled for the way some people will answer yes to any query. These questionnaires were given to psychology students during a class, two to four months before they participated in the experiment, so that they wouldn't know that the experiment had anything to do with them. We also found that previous histories of sensed presence experiences (before the experiment) did have significant correlations with signs of temporal lobe sensitivity, and profound beliefs, such as reincarnation, the conviction that lights in the sky are UFOs controlled by alien beings, and time travel. There were similar correlations between a previous history of spontaneous sensed presence experiences and Christian beliefs, like the second coming of Christ, that Satan is real, and that people need guidance in order to protect their spiritual development.

We did see a weak correlation between feeling the presence during the experiment and the strength of the subjects' religious beliefs. We didn't see the same correlation for people with very sensitive temporal lobes. [For instance, people who experience déjà vu often have more sensitive temporal lobes than those who don't, but it didn't make them any more likely to feel a presence during our stimulation than people who *don't* have déjà vu.]

We analyzed the numbers to see if the subjects' previous experience of spontaneous sensed presences made the sensation more likely during our experiments. We compared our data for this, and several groups of questions on our questionnaires, with the sensed presence data from the stimulation. We found only one with a slight correlation to feeling the sense of a presence during the stimulation, and that was the score for egocentrism.

Direct Experimental Control for Suggestibility

The Uppsala researchers concluded that the results we've reported were due to suggestibility in our subjects, but without actually measuring it in their subjects. However, we did take such measures in several of our studies (totaling 139 male and female volunteers). In these studies, each subject went through the *Hypnosis Induction Profile*, before and after their God Helmet session. This allowed us to measure both their suggestibility and hypnotizability. The procedure was repeated for several different magnetic

signals. We found there were no statistically significant correlations between sensing a presence in our lab and hypnotizability. This showed that suggestibility was not responsible for the effects we reported from our God Helmet sessions. This appeared for both our placebo subjects, and the ones who received the most effective magnetic signal.

In one of our studies, the experimenter did believe that the study was about suggestibility, but didn't know which signal was expected to be most effective. This experiment involved three different magnetic signals and placebo stimulation, as well as the *Hypnosis Induction Profile*. We reanalyzed the data from that experiment to see any associations between 1) hypnotizability and suggestion and 2) the subject's history of spontaneous sensed presences, 3) their New Age beliefs, 4) their traditional religious beliefs and 5) their temporal lobe sensitivity. We found that their scores for suggestibility did not correlate with the strength of their effects from the God helmet stimulation.

Expecting a presence, applying several fields in sequence during the same session, and using the subject as his or her own control.

Some of our studies, using two male and three female experimenters and 47 subjects, each serving as their own control, were designed to clarify what determined where the presence appeared. We could not have done these experiments without describing the sensed presence to the subjects. They were carried out using our normal procedures, including sensory deprivation in our acoustically silent Faraday chamber. The subjects were provided with a button to press on each side, and told to press the one on their left when they felt the presence on the left, and the one on the right when they felt it there. They were given 6 to 8 different magnetic signals or a placebo for five minutes each. These were applied in different orders for different subjects, to counterbalance the sequence of signals. We examined the resulting data to see what determined whether the presence was felt on the left, right, or behind and which signal was most effective in this context.

We recorded the subject's responses in real time and simultaneously monitored their brain activity using EEG. For the most effective signals (the burst-firing, and "chirp" signals) it took between 20 and 60 seconds to see an

EEG response. Neither the subjects nor the experimenters knew which magnetic signal they were receiving, or if it was the placebo. Between 75 and 90% of these subjects pressed the button at least twice during the stimulation in this context.

More than 80% of the presences, elicited by the chirp signal, applied only over the right temporal lobe, resulted in a sense of a presence on their left. Following this with our burst firing signal, derived from the amygdala, over both sides of the brain, elicited the sensed presence over the right for approximately 35% of the subjects, the left for 45% of the subjects and behind or above them for 20%. The experience that “someone was in their mind” or “inserting information into their awareness” appeared with the sense of a presence on the right, but not the left. A signal similar to the Schumann resonance (7.83 Hz), run with higher field strength over the right side, resulted in more EEG spikes from the occipital lobes than other signals. These correlated with the sensed presences on the left, but not the right.

Subjective Experiences

The subjects reported that the experiences feel very emotional and appear to be “real” when the most effective magnetic signals are used. They mean something to the person. [The subjects feel that the experience was “about them”, so they’re more than just observers.] Their descriptions of their experiences, both during the sessions and when recorded immediately afterwards, are as complex, rich, and diverse as any human thought process. We can minimize the seemingly overwhelming volume of details we see in their reports and differences between individual subjects by looking at their most common themes or through measurements of the emotional aspects of the words they used to describe them. [This method uses used the *Whissell Dictionary of Affect in Language*, which measures the “felt” aspect of language across three “dimensions:” Pleasantness, imagery and activation. It’s a list of English words, with each word given a value for how pleasant it appears to be, how easy it is to imagine, and how much activity it seems to denote. This tool for analysis of spoken or written words allows us to measure subjective effects from a stimulus by observing the differences in the way people talk about it before and after.] One of our studies found that the verbal comments from subjects given the burst-firing signal included words

that were significantly less active and more pleasant than the words used by those describing their experiences of placebo stimulation.

A few examples of descriptions from our subjects appear at the end of this paper. Another final addition to this paper shows some common themes and statements by subjects who had been given a series of magnetic signals only over the right hemisphere. [As we have seen in some of our studies, stimulation of only the right hemisphere tends to be unpleasant, excepting the Hippocampal signal.] The qualitative differences we see between reports of the effects, arising from different signals and the places we apply them, are similar to the differences we see in subjects who had been given hallucinogenic drugs, and those who were given placebos. While both hallucinogenic drugs and right hemispheric stimulation create reports of colors and lattices, the form and the colors of these hallucinations were different. In about 20% of cases, the presence seemed to move when the subject tried to focus on its specific location. If we stopped the signal without telling the subject, the "presence" faded away in less than five seconds.

A feeling of "evil," was more common in ["right side only" stimulation and their ensuing] left-sided experiences, and appeared for about 40% of more than 200 subjects who were asked about this specific sensation. This is normal with other kinds of stimulation, when they're applied only to the right hemisphere [like stimulation with an electrode during open-brain surgery]. In contrast, the presences that appeared along the right side were noticeably pleasant. Almost all of the volunteers who had used "mind-altering" drugs said that their experiences with the magnetic signals were similar. Over 75% of the subjects who had histories of "visitations" by nonphysical beings, [an experience more dramatic than the simple sense of a presence] reported that they had reappeared during their God Helmet session.

The Importance of Precision in the Timing and Shape of the Signal.

The most likely explanation for the difference between our results and those of the Swedish group lies in the way they tried to output the critical shapes the magnetic signals require. [Even small distortions can prevent the signals from having their effects.] The software to generate them was designed for 286 PC computers [8 to 20Mhz processors, first issued in the

early 1980s], running the DOS operating system. The Swedish group used a Pentium computer with a 144 MHz processor, in a “DOS shell” on a computer running Windows 95. [This meant that computer was running too fast, and required a calibration program to slow down the signals to match the faster processor speed. They were informed of this limitation when they were provided with our software.] Faster computers, and Windows 95 in particular, distort the signals by slowing down the time the computer spends on each “pixel” in the signal. They also distort its shape, so that they no longer match the EEG signal they were based on, and can no longer influence brain activity. [The signals “warbled” when they went through the serial (LPT) port under Windows, even when our software is run in a DOS shell. They’re only stable in a native DOS environment. The Uppsala group effectively ran the software under Windows, which still controlled the output to be LPT port, and added its distortion]. In some of our rat studies, we found that the strength of the analgesic effects from the “burst-firing” signal was eliminated by small changes in the duration of the signal, similar to the way a drug’s effects can be blocked by small changes in its chemical structure; even changing the location of just a single atom. In our experiments, we verified that the signal was present, and being produced correctly for all of our subjects. [The output from the computer to the digital to analog converter went through the LPT (printer) port. Today, there are USB computer sound devices eliminate the need to calibrate the signals to the processor speed, so this issue doesn’t appear with today’s newer PC God Helmet software.]

Conclusions

Our re-analysis of 19 experiments, carried out over the last 15 years, show that the sense of a presence, or the feeling that a sentient being is nearby, can indeed be produced in the laboratory. It appears most frequently when the right magnetic signals, with *undistorted* internal structures (or “shapes”) are used to stimulate the temporal lobes, especially when the field strength is higher over the right side. The effect size (how often and how many subjects experienced the sense of a presence) through all our experiments was similar to what we found both with and without double-blind conditions. [For example, the “button press” experiments required us to inform the subjects that they might experience the sense of a presence. Had

we not informed them, they would not have known what to do with the buttons, used to indicate whether it appeared on their left or right side. Naturally, these experiments could not be double-blind. However, we were still able to use placebo controls and conceal which signals were applied, and in what order, from both subjects and experimenters.]

Specific magnetic signals were still most effective when the experimenters weren't told the purpose of the study, or were actually given misleading expectations [such as being told the experiment was about memory functions]. When the subjects were allowed to expect the sense of a presence, but didn't know whether they were being given real stimulation or a placebo, our burst firing signal still elicited substantially more sensed presence moments than the placebo controls. Although subjects with higher temporal lobe sensitivity responded more than others to some of our signals, more suggestible subjects didn't specifically feel a presence more often than others.

Through the centuries, the sense of a presence has been associated with mysticism, inspiration, creativity, and contact with "divine", "non-physical" or "other-dimensional" beings. Every culture has its variations on the theme. The very personal and profound experiences that our subjects reported after brief (20-30 minute) exposures to the correctly-shaped magnetic signals, over the temporal lobes, imply that our procedures can elicit the same peripheral phenomena and themes we find with spontaneous, natural sensations of a presence. If all human experiences are created within the brain, then the correct neural stimulation, in the right place, should be able to produce the subjective experience of deities and other anthropomorphic immaterial beings, with properly conducted laboratory procedures.

Appendix A

Here are some examples of commentary from some of our subjects. They believed they were part of a relaxation experiment and were given the magnetic signals with different variations (parameters). [*NOTE*: these comments are *not* from the kind of sessions that created positive, spiritual experiences.]

From a middle-aged professional journalist (being given the “chirp” signal, over only the right hemisphere) - “I see shadows along my left side … There is someone touching my left side … There is a flash of light … A tunnel experience. I feel as if I am shrinking and expanding. [These sensations are known as macropsia and macropsia.] There’s a tingling inside of my thigh … Sexual excitement. There’s a cold rush (the subject shivered and their EEG showed paroxysmal activity). I see a visual … It’s an apparition.”

From a 20-year-old woman with a history of diabetes, receiving the burst firing pattern over both temporal lobes - “I felt a presence behind me and then along the left side. The presence moved when I tried to focus on its position. Every time I tried to sense where it was, it moved around. When it moved to the right side, I experienced a deep sense of security like I had not experienced before. I started to cry when I felt it slowly fade away” (this happened when we changed the time between each instance of the signal).

From a 30-year-old woman, receiving the “chirp” signal, set up so that the field strength was higher over the right side of the brain. - “I feel detached from my body. I’m floating up … There is a kind of vibration moving through my sternum … There are lights or faces along my left side. My body is becoming very hot … Tingling sensations in my chest and stomach … (and now) both arms. There’s something feeling my ovaries. I can feel my left foot jerk. I feel there’s someone in the room behind me.”

From a 25-year-old man, with a history of three “mild” head injuries during childhood. He received the “chirp” signals over both temporal lobes. “I feel as if there was a bright white light in front of me. I saw a black spot that became a kind of funnel … no, tunnel - that I felt drawn into. I felt moving, like spinning forward, through it. I began to feel the presence of people, but I could not see them; they were along my sides. They were colorless, grey-looking. I know I was in the chamber but it was very real. I suddenly felt intense fear and felt ice cold.”

Appendix B

These are some of the most common themes and events reported by button-press subjects as they were being given different sequences of various

magnetic signals over the right hemisphere. These comments appeared when the fields were being applied. [Remember that stimulation over only the right side can create unpleasant sensations and hallucinations. Although stimulation of only the right side is one part of the session design that creates spiritual experiences, these are more likely in its second phase, when another signal was applied over both sides. This means that the experiences mentioned below are very different from the most effective God helmet session.]

Typical experiences from sessions designed to be unpleasant or neutral, stimulating only the right hemisphere will:

1. A dark, ominous force looming directly above the person (as though it were going to lower itself onto them).

2. A feeling of suffocation or pressure on the chest.

3. The sensation of “blacker than black” during short periods, starting less than a minute after we began stimulation with the “chirp” signal.

4. Re-experiencing prior altered states, like kundalini, haunt experiences, and episodes with hallucinogenic drugs. (These subjects hadn’t experienced these states again until they were given at least one of our magnetic signals)No, you should not hear anything. If an.

5. About 20% of the subjects in the “button press” experiments pressed the button in response to feeling the sense of a presence, but had no memory of it 15 to 20 minutes later.

6. Brief images of religious figures, visions of priests, and even human skeletons appeared as repeating visual “flashes”.

CHAPTER TWENTY ONE

9 Blogs by Dr. Michael Persinger and Todd Murphy.

Drafted by Todd Murphy, edited and signed by Dr. Michael A. Persinger.

Originally published online in 2015.

Blog One

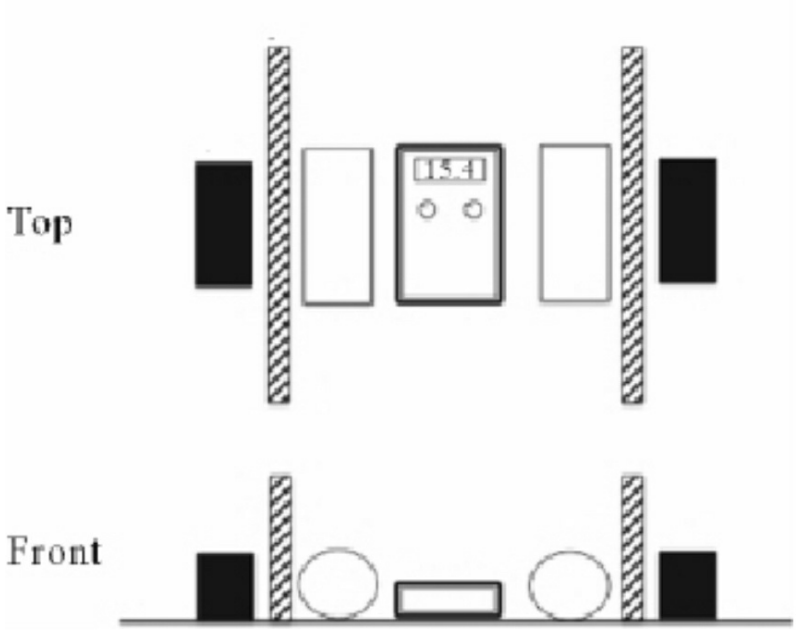
The God Helmet's Weak Fields are Sufficient to Influence Brain Activity – A blog By Dr. M. A. Persinger

The mistaken claims that our magnetic fields can't affect the brain ignore the evidence.

Question: Is there any truth to the claim that your magnetic fields cannot influence the brain?

Answer: No. Recently, a colleague and I performed an experiment using three materials, each three times as dense and thick as the human skull (wood, saline solution or duct metal) to demonstrate that there is no validity to claims that weak, time-varying magnetic fields applied in this manner are eliminated or significantly attenuated (weakened) by the human skull. The result was straightforward: The fields were not attenuated (weakened) in any way.

Persinger, Michael A., and Kevin S. Saroka. "Minimum Attenuation of Physiologically-Patterned, 1 μTesla Magnetic Fields through Simulated Skull and Cerebral Space." *Journal of Electromagnetic Analysis and Applications* 5.04 (2013): 151.



A schematic diagram of the testing apparatus for the experiment. Two wooden pine boards or duct metal were periodically inserted between the SAM-360 (vis. God Helmet) device and the power meter. In one case, physiological saline was placed adjacent to the power meter.

The claim that magnetic fields cannot influence the brain is based on a fallacious interpretation of TMS (Transcranial Magnetic Stimulation), which uses magnetic fields strong enough to depolarize neurons, and force current induction. Typically, these fields are a million times stronger than the kind that surrounds stereo headphones. This “brute force” approach has several clinical applications. Critics claim that neural stimulation employing fields with lower strengths can’t have any effect. A brief look at the relevant laws of physics and laboratory evidence shows us that this simply isn’t the case.

It should be understood that any claim that magnetic fields can’t penetrate the head are contrary to the laws of physics, which tell us that the head cannot act as a magnetic insulator (and neither can anything else), because these same laws deny the existence of magnetic insulation. This has to do with one of Maxwell’s Equations (del dot B = 0). All magnetic field lines must terminate on the opposite pole. Because of this, there is no way to stop them; they must all find a way to return the magnetic field lines back to an opposite pole.

This is how it is explained in the *theories* of physics. When we

examine the question *empirically*, we find that there is a substantial body of evidence showing that weak magnetic fields do penetrate the head, and that they can also influence brain activity. Let me address how this happens.

In classical physics, a changing magnetic field produces an electric field and an electric current. The amount of current depends upon the conductivity of the substance, whether it's a copper wire or our brain tissues. That's how TMS works. However, there is also *magnetic energy*.

When we apply our magnetic fields, with strengths a million times less than TMS, the energy within the volume of the person's brain is about a nanoJoule (one billionth of a Joule) per second. When we average this out over the about 100 billion neurons (and their support cells) in the human brain, that works out to about 10^-20 Joules per cell each second. The number is a decimal point followed by 19 zeros and then a 1. This may seem very, very small. Actually, it matches the amount of energy involved when a single nerve cell produces one action potential that contributes to our present-time subjective experience. Moreover, a change in the activity of one neuron can alter the state of the entire brain (Cheng-Yu, 2009). This small quantity of energy is also the same as the amount that binds chemicals to cells through receptors.

However, the values can be enhanced. Our brains are richly populated with crystalline magnetite, containing 5 million such crystals per gram (Kirschvink, 1992a). They appear in chains ("magnetosomes"). In the vernacular, our fields work because these chained crystals move in response, and because the information encoded in their movement (coming from our signals); their "patterns", interacts with the magnetic fields that appear as a consequence of the brain's electrical activity, a "field to field" effect. Imagine the sun has a storm, making its magnetic field pulse slowly. Here, on the earth, we would have geomagnetic storms, as pulses from the sun's stormy field are added to that of our planet. We have found the same field that produced the sensed presence works by very specific channels within membranes that allow calcium to enter the cell (Buckner et al, 2015). The timing of the point durations that compose the specific field pattern must be precise or there is no effect.

One of the pioneers in biological aspects of magnetic fields, Joseph

Kirshvink (1992b) wrote: “A simple calculation shows that magnetosomes [chains of magnetic particles] moving in response to earth-strength ELF fields are capable of opening trans-membrane ion channels, in a fashion similar to those predicted by ionic resonance models. Hence, the presence of trace levels of biogenic [produced or brought about by living organisms] magnetite in virtually all human tissues examined suggests that similar biophysical processes may explain a variety of weak field ELF bioeffects”.

The magnetic fields that surround stereo headphones are in the same range, but are not embedded with neural information.

The reader can see 10 examples of magnetic stimulation studies below. Only independent studies are listed. The magnetic stimulation reported in them run from a quarter of the field strengths used in TMS (1 Tesla) to less than a millionth of that value. Each listing shows:

- The unit of magnetic field measurement used in the research publications.
- The equivalent field strength in milligauss (mG), so that the same unit of measurement can be seen for all the cited studies.
- The percent of the fields employed in TMS.
- A brief summary of each result.
- A link to the publication.

These are displayed below in descending order of field strength, and they range from one quarter (25%) to five ten-billionths (5 x 10 -13%) of the field strength used in TMS.

Wieraszko (2000) used a 2.5 milliTesla field (= 25,000 mG, which equals 0.25% of TMS) to exert effects on spikes from hippocampal slices in vitro:

Wieraszko, A. “Dantrolene modulates the influence of steady magnetic fields on hippocampal evoked potentials in vitro.” *Bioelectromagnetics* 21.3 (2000): 175-182.

http://www.ncbi.nlm.nih.gov/pubmed/10723017

Dobson, Jon, et al. (2000) used a 1.8 milliTesla field (= 18,000 mG, or 0.18% of the fields strengths used in TMS) to enhance and suppress interictal (between seizure) epileptiform activity in temporal lobe epileptics.

Dobson, Jon, et al. "Changes in paroxysmal brainwave patterns of epileptics by weak - field magnetic stimulation." Bioelectromagnetics21.2 (2000): 94-99.
http://www.ncbi.nlm.nih.gov/pubmed/10653619

Thomas (et al.), 2007 used a 400 microTesla magnetic field (=4,000 mG which equals 0.04% of the fields used in TMS) for pain reduction in patients with fibromyalgia.

Thomas, Alex W., (et al.) "A randomized, double-blind, placebo-controlled clinical trial using a low-frequency magnetic field in the treatment of musculoskeletal chronic pain." *Pain Research & Management: The Journal of the Canadian Pain Society* 12.4 (2007):249.
http://www.ncbi.nlm.nih.gov/pubmed/18080043

Huesser, (et al.) 1997 used a 0.1 microTesla magnetic field (= 1000 mG , which equals 0.01% of the fields used in TMS) to cause changes in EEG parameters.

Heusser, Karsten, Dieter Tellschaft, and Franz Thoss. "Influence of an alternating 3 Hz magnetic field with an induction of 0.1 MicroTesla on chosen parameters of the human occipital EEG." *Neuroscience letters*239.2 (1997): 57-60.
http://www.ncbi.nlm.nih.gov/pubmed/9469655

Marino (et al., 2004) used a 1 Gauss magnetic field (= 1000 mG, which equals 0.01% of the fields used in TMS) to cause changes in EEG readings during presentation of Magnetic fields

Marino, Andrew A., et al. "Effect of low-frequency magnetic fields on brain electrical activity in human subjects." *Clinical Neurophysiology*115.5 (2004): 1195-1201.

http://www.ncbi.nlm.nih.gov/pubmed/15066545

Carrubba et al., (2008) used a 2 Gauss magnetic field (= 2000 mG, which equals 0.02% of the field strengths used in TMS) to elicit magnetosensory evoked potentials.

Carrubba, Simona, et al. "Magnetosensory evoked potentials: consistent nonlinear phenomena." *Neuroscience research* 60.1 (2008): 95-105. http://www.ncbi.nlm.nih.gov/pubmed/18036693

Note: The same researcher also found EEG activation in response to magnetic fields with 1 Gauss field strengths (0.01% of the field strengths used in TMS.
http://www.ncbi.nlm.nih.gov/pubmed/17350168

Brendel et al., (2000) used an 86 microTesla magnetic field (= 860 mG or 0.0086% of the field strengths used in TMS) to elicit melatonin suppression following *in vitro* pineal gland exposure to magnetic fields.

Brendel, H., M. Niehaus, and A. Lerchl. "Direct suppressive effects of weak magnetic fields (50 Hz and 162/3 Hz) on melatonin synthesis in the pineal gland of Djungarian hamsters (Phodopus sungorus)." *Journal of pineal research* 29.4 (2000): 228-233.
http://www.ncbi.nlm.nih.gov/pubmed/11068945

Bell et al. (2007) used a 0.78 Gauss magnetic field (=780 mG or 0.0078% of the fields used in TMS) to induce increased EEG activity at two or more frequencies.

Bell, Glenn B., Andrew A. Marino, and Andrew L. Chesson. "Alterations in brain electrical activity caused by magnetic fields: detecting the detection process. "*Electroencephalography and clinical Neurophysiology* 83.6 (1992): 389-397. http://www.ncbi.nlm.nih.gov/pubmed/1281085

Vorobyov, et al., (1998) used a 20.9 microTesla magnetic field (=209 mG or 0.0029% of the field strengths used in TMS) to influence EEG differences in rats.

Vorobyov, Vasily Vasilievitch, et al. "Weak combined magnetic field affects basic and morphine-induced rat's EEG." *Brain research* 781.1 (1998): 182-187.
https://www.ncbi.nlm.nih.gov/pubmed/9507115

Tinoco & Ortiz (2014) used a 1 microTesla magnetic field (=10 mG or 0.0001% of the fields strengths used in TMS) to replicate one of Persinger's published God Helmet effects.

Tinoca, Carlos A., and João PL Ortiz. "Magnetic Stimulation of the Temporal Cortex: A Partial "God Helmet" Replication Study." *Journal of Consciousness Exploration & Research* 5.3 (2014).
https://www.scribd.com/doc/267811996/God-Helmet-Replication-Study

---

Jacobson (1994) used a 5 picoTesla magnetic field (= 0.00005 mG or 0.000000000005% of the field strengths used in TMS), and observed a direct correlation of melatonin production with magnetic field stimulation.

Jacobson, J. I. "Pineal-hypothalamic tract mediation of picoTesla magnetic fields in the treatment of neurological disorders." *Panminerva medica* 36.4 (1994): 201-205. (See evidence)

Sandyk, (1999) "picoTesla range" used 500 picoTesla (=0.005 milligauss or 0.00000000005% of the field strengths used in TMS) magnetic fields improve olfactory function in Parkinson's disease.

Sandyk, Reuven. "Treatment with AC pulsed electromagnetic fields improves olfactory function in Parkinson's disease." *International journal of neuroscience* 97.3-4 (1999): 225-233.

http://www.ncbi.nlm.nih.gov/pubmed/10372649

NOTE: Sandyk has published scores of case histories documenting the effects of picoTesla range magnetic fields on humans, including in MS and Parkinson's.

Other References:

Cheng-yu, T. Li, Mu-ming Poo, and Yang Dan. "Burst spiking of a single cortical neuron modifies global brain state." *Science* 324.5927 (2009): 643-646.

Kirschivink, Joseph L., Kobayashi-Kisshvink, Atsuko & Woodford, Barbera J. "Magnetite biomineralization in the Human Brain", *Proceedings of the National Academy of Science* 1992 (A), 89 7683-7687

Kirschvink, Joseph L., et al. "Magnetite in human tissues: a mechanism for the biological effects of weak ELF magnetic fields." *Bioelectromagnetics* 13.S1 1992 (B): 101-113.

Buckner CA, Buckner AL, Koren SA, Persinger MA, Lafrenie RM (2015) Inhibition of Cancer Cell Growth by Exposure to a Specific Time-Varying Electromagnetic Field Involves T-Type Calcium Channels. *PLoS ONE* 10(4): e0124136. doi:10.1371/journal.pone.0124136

I hope this blog will clarify that the magnetic fields we utilize in the God Helmet can indeed affect brain activity, and that claims to the contrary contradict the laws of physics and are made without examination of the evidence.

End.

Blog Two

We Do Not Allow Suggestion or Suggestibility to Influence our Lab Results. – A Blog by Dr. M.A. Persinger

We take every measure to ensure that our subjects are not exposed to suggestions.

We apply several procedures to guarantee that our subjects are not exposed to suggestions and have no expectations, so that our results are not influenced by subject suggestibility.

These procedures and analytical methods rule out suggestion as an explanation for the effects we've seen in our experiments.

Question: How do you ensure that subjects are not inadvertently given suggestions as to the purpose of your experiments and how do you respond to the claim that your results are due to suggestibility?

Human beings are remarkably sensitive to subtle cues in their environment. For example, specific areas of the human brain respond to alterations in sentence structure while a person is reading, even though they aren't "aware" of the change. (Bern, 1997).

Thirty years ago when we were interested in the "subjective narrative" of people sitting in the dark in a quiet chamber we found that the music, e.g., a Gregorian chant or the bars from the movie Close Encounters of the Third Kind, compared to sitting in silence, affected the content of the "spontaneous" themes. Sitting in silent darkness without previously hearing any music generated more "death" images, the pre-darkness listening to Gregorian chants was associated with more religious images and the movie's melody fragment was associated with space themes. We could influence what the subjects thought about by "priming" them with music with clear connotations.

Context is also important (Persinger, 1989; 1992). In one of our placebo-controlled experiments, we applied our magnetic signals, and immediately afterwards, the subjects listened to an ambiguous narrative (story) about a young boy who had night time apparition experiences ("The Billy Story"). These were epileptic in origin, although this was never stated. After the story and the stimulation was complete, we asked the subjects to listen to a brief

story about either alien abduction or early sexual abuse. The story was provided without any explanation. The subjects were then asked to interpret the story about the boy's night time experiences both immediately and a few days after. We found that the subjects who heard the story about early sexual abuse interpreted the "Billy" story as one of sexual abuse, and the subjects who heard the story about alien abductions interpreted it as being about an interaction with aliens. (Dittburner and Persinger, 1993; O'Gorman and Persinger, 1998). In this way, we verified how easily *pseudomemories* (or false memories) can be produced (Persinger, 1992; Healey and Persinger, 2001).

My critics who attribute God Helmet experiences to suggestibility have never directly tested this hypothesis. We *have* tested this potential confounding effect by psychometric inferences, which are highly correlated with hypnotizability, such as the *Wilson-Barber Imaginings Scale*. We also have several experiments where we measured hypnotizability directly with the *Spiegel and Spiegel scale* where the experimenter interacts with the subject directly (Ross and Persinger, 1987). The latter was administered *after* the exit questionnaire containing 20 questions about their experiences.

Interestingly, the last item in this questionnaire asks if the red light changed intensity even though for most studies *there was no red light*. Suggestible or highly hypnotizable individuals frequently respond "yes" to this item. However, even when the many suggestibility measures were taken into account during the statistical analyses, the sensed presence reports still occurred primarily when the "God Experience" protocol was used.

Dr. Linda St-Pierre and I explained this in our 2006 paper in the *International Journal of Neuroscience*, but online skeptics seem not to have read it. Finally I reiterate that the volunteers do not know if they will receive a magnetic field or which field it might be and they are always told they are participating in a relaxation or [in some cases] a memory study.

We use questionnaires with our student subjects. The questionnaires are applied at least six weeks before these students participate, and these are only some of the questionnaires they students fill out as they study psychological data gathering. This gives them first hand experience with methods of

gathering psychological data. They had no idea that the questions have anything to do with the experiment. The data are gathered under “blind” conditions.

We don’t decorate our lab with any spiritual or religious imagery, and the researchers don’t discuss the specifics of the experiment with subjects until after all data has been gathered.

Our experiments have made it clear that our effects were not coming from suggestion. After experimenting for several years with a burst-firing pattern, and seeing repeated results telling us that it generated higher pleasantness ratings when applied over the *left* hemisphere (see example; Persinger & Healey, 2002), we began to investigate another signal, derived from hippocampal tissues during long-term potentiation. In that case, and a few since, we have seen that this signal is more pleasant over the *right* hemisphere (Persinger, et al., 1994). If our effects were due to suggestion, these results should have been the same in all cases, but they weren’t.

I hope this blog clarifies that we are aware of experimental factors that allow suggestions and suggestibility to confound experimental results, and that we take all necessary steps to prevent their occurrence.

REFERENCES:

Berns, Gregory S., Jonathan D. Cohen, and Mark A. Mintun. “Brain regions responsive to novelty in the absence of awareness.” *Science*276.5316 (1997): 1272-1275.

Dittburner, T.-L. and Persinger, M. A. (1993). Intensity of amnesia during hypnosis is positively correlated with estimated prevalence of sexual abuse and alien abductions: implications for false memory syndrome. *Perceptual and Motor Skills*, 77, 895-898.

Healey, F. and Persinger, M. A. (2001). Experimental production of illusory (false) memories in reconstructions of narratives: effect size and potential mediation by right hemispheric stimulation from complex, weak magnetic fields. *International Journal of Neuroscience*, 106, 195-207.

O’Gorman, K. A. and Persinger, M. A. (1998). Hypnotic Induction

profiles, contextual innuendo and delayed intrusion errors for a narrative: searching for mediating variables. *Perceptual and Motor Skills*, 87, 587-593.

Persinger, M. A. (1989). Geophysical variables and behavior: LV. Predicting the details of visitor experiences and the personality of experients. *Perceptual and Motor Skills*, 68, 55-65.

Persinger, M. A. (1992). Neuropsychological profiles of adults who report "suddenly remembering" of early childhood memories: implications for claims of sexual abuse and alien visitations/abduction experiences. *Perceptual and Motor Skills*, 75, 259-266.

Persinger, M. A. (1996). Subjective pseudocyesis in normal woman who exhibit enhanced imaginings and elevated indicators of electrical lability within the temporal lobes: implications for the "Missing Embryo Syndrome". *Social Behavior and Personality*, 24, 101-112.

Ross, J. and Persinger, M. A. (1987). Positive correlations between temporal lobe signs and hypnosis induction profiles: a replication. *Perceptual and Motor Skills*, 64, 828-830.

St-Pierre, L. S. and Persinger, M. A. (2006). Experimental facilitation of the sensed presence is predicted by specific patterns of applied magnetic fields not suggestibility: re-analysis of 19 experiments. *International Journal of Neuroscience*, 116, 1-8.

Spiegel, H. and Spiegel, D. (1978). *Trance and treatment: clinical uses of hypnosis.* New York: Basic Books.

Persinger, Michael A., and Faye Healey. "Experimental facilitation of the sensed presence: Possible intercalation between the hemispheres induced by complex magnetic fields." *The Journal of nervous and mental disease* 190.8 (2002): 533-541.

Persinger, Michael A., Pauline M. Richards, and Stanley A. Koren. "Differential ratings of pleasantness following right and left hemispheric application of low energy magnetic fields that stimulate long-term potentiation." *International journal of neuroscience* 79.3-4 (1994): 191-197.

Blog Three

Our results can't be attributed to suggestion. – A blog By Dr. Michael Persinger

Question: What results have you had that cannot be explained by suggestion?

Answer: We have seen many effects that can't be explained by suggestion or suggestibility. These have been done with people, rats, worms and living cells maintained (cultured) in petri dishes.

One very clear illustration is seen in our study that found that our magnetic field stimulation actually enhanced hypnotizability (Tiller, 1994) with a pulsed field, which we replicated two years later (Healey, 1996) with a burst-firing pattern. We took measures of the suggestibility of each subject using an established instrument for its measurement as part of these experiments (Spiegel, 1978). Altering suggestibility through suggestion is a highly improbable scenario, so the results of these studies ruled it out as an explanation for our magnetic stimulation effects in humans approximately twenty years ago.

For many of our experiments that created the sensed presence, we measured suggestibility directly using a well-established protocol (Spiegel, 1978). We found that analyzing the data for the person's hypnotizability

score did not reduce the intensity of the sensed presence produced by the specific magnetic field pattern. The key paper was called “Experimental facilitation of the sensed presence is predicted by specific patterns of applied magnetic fields not by suggestibility: re-analysis of 19 experiments”. It was published in the International Journal of Neuroscience (St-Pierre, LS, 2006).

We’ve also observed clinical effects that cannot be explained by suggestion. For example, Baker-Price (1996) found differential changes in the EEG patterns of patients who had sustained head injuries, depending upon the specific neural location where the field was applied. The experiment also found a significant improvement of depression and a reduction of phobias. We replicated this experiment in 2003 (Baker-Price, 2003), with very similar results and follow-up six weeks after the experiment was completed. Tsang et al (2009) showed clearly with relatively crude psychometric measurements that infer emotional profiles how different patterned fields produced different mood states. Attributing these results to patient suggestibility leads inevitably to the conclusion that depression can be treated through suggestion, a conclusion neither supported by any evidence nor predicted by any hypotheses.

We have also seen clear changes in delta and theta power over the temporal lobes during magnetic field stimulation (and more accurate brain wave measures, such as QEEG), (Corradini, et al. 2013), using a completely separate method for producing the signals. Eliciting the same effects with both different hardware and software also allows confirmation that our results that cannot be attributed to hardware artifacts.

However, the most powerful demonstration that the electromagnetic effects are not due to suggestion is the effect upon cells. We have found in controlled studies that the same pattern using in our sensed presence experiments slows the rate of a variety of different types of cancer cells in cultures (Hu, et al., 2010, Bruckner, 2015). These fields inhibited only cancer cell growth but did not retard the growth of normal cells. We have found this same field that produced the sensed presence works by very specific channels within membranes that allow calcium to enter the cell (Buckner et al, 2015). The timing of the point durations that compose the specific field pattern must be precise or there is no effect.

Our studies using lab rats cannot be attributed to suggestion as rats cannot be said to be “suggestible”.

Nevertheless, we carry out blind analysis of rat brain sections in our rat studies, in which the investigator does not know which brain regions may have been affected by a procedure or the extent of the differences predicted between the rat brains exposed to the magnetic fields and those that were not (Fournier, 2012). In rat studies investigating differences in behavior following stimulation with magnetic signals, the experimenter observing their behavior is kept blind to the experimental condition (Whissell, 2007, McKay, 2004, Bureau, 1994, Babik, 1992). Our examination of microscope slides from rat subjects and controls is also done under blind conditions (Cook, 1999). We have also carried out similar procedures with worms (planarium – *Dugesia sp*.) (Mulligan, 2012).

The false impression that our effects come from suggestibility in our experimental participants originates from a paper published by Granqvist et al.. That publication reported an incorrectly configured experiment in which our neural stimulation signals were run at too high a velocity (their computer wasn’t calibrated to the software) and for too short a time (only ten minutes instead of the twenty we normally use as the minimum stimulation). There were other issues, but these were the most significant. Granqvist, et al. explained the difference between our results and theirs by the speculation that our results were due to suggestibility in our subjects. Note that Granqvist et al did not actually measure their subject’s suggestibility. Their explanation is entirely speculative and ultimately incorrect.

I hope this blog will clarify that we are fully aware of the need to prevent experimenter suggestions and that our results are not due to to suggestibility in our subjects.

Dr. Michael A. Persinger

REFERENCES

Tiller, S. G., and Michael A. Persinger. “Enhanced hypnotizability by cerebrally applied magnetic fields depends upon the order of hemispheric presentation: An anistropic effect.” International journal of neuroscience

79.3-4 (1994): 157-163.

Healey, Faye, Michael A. Persinger, and S. A. Koren. “Enhanced hypnotic suggestibility following application of burst-firing magnetic fields over the right temporoparietal lobes: A replication.” *International journal of neuroscience* 87.3-4 (1996): 201-207.

Spiegel, H. & Spiegel, D. (1978) Trance and treatment. Basic Books: N.Y.

Pierre, LS St, and M. A. Persinger. “Experimental facilitation of the sensed presence is predicted by the specific patterns of the applied magnetic fields, not by suggestibility: re-analyses of 19 experiments.” *International Journal of Neuroscience* 116.19 (2006): 1079-1096.

Baker-Price, L. A., and Michael A. Persinger. “Weak, but complex pulsed magnetic fields may reduce depression following traumatic brain injury.” *Perceptual and motor skills* 83.2 (1996): 491-498.

Baker-Price, Laura, and Michael A. Persinger. “Intermittent burst-firing weak (1 MicroTesla) magnetic fields reduce psychometric depression in patients who sustained closed head injuries: A replication and electroencephalographic validation.” *Perceptual and motor skills* 96.3 (2003): 965-974.

Tsang, Eric W., Stanley A. Koren, and Michael A. Persinger. “Specific patterns of weak (1 microTesla) transcerebral complex magnetic fields differentially affect depression, fatigue, and confusion in normal volunteers.” *Electromagnetic biology and medicine* 28.4 (2009): 365-373.

Corradini, Paula L.; Mark W. G. Collins; Dr. Michael A. Persinger “Facilitation of Declarative Memory and Congruent Brain States by Applications of Weak, Patterned Magnetic Fields: The Future of Memory Access?” *International Journal of Humanities and Social Science* Vol. 4, No. 13; November 2014

Hu, Jing H., et al. “Growth of injected melanoma cells is suppressed by whole body exposure to specific spatial-temporal configurations of weak intensity magnetic fields.” *International journal of radiation biology* 86.2

(2010): 79-88.

Buckner CA, Buckner AL, Koren SA, Persinger MA, Lafrenie RM (2015) Inhibition of Cancer Cell Growth by Exposure to a Specific Time-Varying Electromagnetic Field Involves T-Type Calcium Channels. *PLoS ONE* 10(4): e0124136. doi:10.1371/journal.pone.0124136

Whissell, P.D. , Persinger, M.A.; "Developmental effects of perinatal exposure to extremely weak 7 Hz magnetic fields and nitric oxide modulation in the Wistar albino rat " *International Journal of Developmental Neuroscience* 25 (2007) 433–439

McKay, B. E., and M. A. Persinger. "Normal spatial and contextual learning for ketamine-treated rats in the pilocarpine epilepsy model." *Pharmacology Biochemistry and Behavior* 78.1 (2004): 111-119.

Bureau, Y. R. J., O. Peredery, and M. A. Persinger. "Concordance of quantitative damage within the diencephalon and telencephalon following systemic pilocarpine (380 mg/kg) or lithium (3 mEq/kg)/pilocarpine (30 mg/kg) induced seizures." *Brain Research* 648.2 (1994): 265-269.

Missaghi, Babik, Pauline M. Richards, and Michael A. Persinger. "Severity of experimental allergic encephalomyelitis in rats depends upon the temporal contiguity between limbic seizures and inoculation." *Pharmacology Biochemistry and Behavior* 43.4 (1992): 1081-1086.

Cook, Lisa L., and M. A. Persinger. "Infiltration of lymphocytes in the limbic brain following stimulation of subclinical cellular immunity and low dosages of lithium and a cholinergic agent." *Toxicology letters* 109.1 (1999): 77-85.

Mulligan, Bryce P. , Noa Gang, Glenn H. Parker, Michael A. Persinger "Magnetic Field Intensity/Melatonin-Molarity Interactions: Experimental Support with Planarian (Dugesia sp.) Activity for a Resonance-Like Process" *Open Journal of Biophysics*, 2012, 2, 137-143

Blog Four

Much of our work, including with the God Helmet, has indeed been replicated. Claims to the contrary are mistaken – A Blog by Dr. Michael A Persinger.

Question: Have any God Helmet effects been replicated? Have other results from your lab have seen replication?

Answer. Yes. Every major discovery we have published that was considered “novel” has been replicated when the researcher followed the correct procedure.

A replication of God Helmet effects was published in 2014 by a pair of Brazilian researchers (Tinoco, et al. 2014). Their report very closely replicates one of our early studies (Richards & Persinger, 1993), using the same analytical method that distinguished subjects from controls. That study concluded that our results are “attributable to the fields and their configurations, not to suggestibility”. This refutes the claims that our results come only from suggestible subjects. These mistaken claims come from a researcher (Granqvist et al.) who did not set up his equipment properly. To explain his lack of results, he claimed that none were possible, and to explain our results, he claimed that we used improper methods with suggestible subjects. Actually, we do use double-blind and placebo controlled methods, (See blog #5). I and my colleagues have answered these claims formally in the literature (St-Pierre, 2006; Persinger 2005) and reviewed the methodological issues informally online.

The Granqvist et al. study was not designed to be a replication. They did not use the well-known helmet but instead employed a prototype device we made for them so they could study PET (Positron Emission Tomography) effects. This is what they claimed they were going to do when they visited the laboratory, and that was what we had in mind when we gave them their instructions for its use. They didn’t follow the precise timing procedures needed to generate the fields. The effects do not occur without this precision timing. Granqvist et al. presented distorted signals, and their scores for their sham (placebo) and treatment groups were the same as the scores for our sham groups. Effective magnetic signals are sensitive to the

complexity of the timing of their components, just as chemical actions depend on the exact shape of the chemicals being employed. It is like changing a component of a drug and then wondering why it doesn't work.

Granqvist wrote: "Such weak fields are considered unable to induce currents strong enough to depolarize neurons. [No one ever claimed that the God Helmet works by depolarizing neurons, which does happen with rTMS] Thus, the mechanism through which weak complex field(s) … may work remains obscure, but the waveform of the field has been suggested to be crucial" (Granqvist, 2004). In fact, there is nothing obscure about how the fields work in the brain.

One of the pioneers in biological aspects of magnetic fields, Joseph Kirshvink (1992a) wrote: "A simple calculation shows that magnetosomes [chains of magnetic particles] moving in response to earth-strength ELF fields are capable of opening trans-membrane ion channels, in a fashion similar to those predicted by ionic resonance models. Hence, the presence of trace levels of biogenic [produced or brought about by living organisms] magnetite in virtually all human tissues examined suggests that similar biophysical processes may explain a variety of weak field ELF bioeffects". It appears that Granqvist didn't read this.

Our brains are richly populated with crystalline magnetite, containing 5 million such crystals per gram (Kirschvink, 1992 B). In the vernacular, our fields work because these crystals move in response and because the information encoded in their movement (coming from our signals); their "patterns", interact with the magnetic fields that appear as a consequence of the brain's electrical activity, a "field to field" effect. We have found this same field that produced the sensed presence works by very specific channels within membranes that allow calcium to enter the cell (Buckner et al, 2015). The timing of the point durations that compose the specific field pattern must be precise or there is no effect.

Notwithstanding the explanation for the effects of the fields, we also know of at least a dozen researchers who have observed measurable effects from magnetic fields that are significantly weaker than TMS. These corroborate our reports of measurable bioeffects from weak magnetic fields and demonstrate that depolarizing neurons is not the only way

magnetic fields can influence the brain. We also did a study to demonstrate the permeability of the skull and cerebral space to magnetic fields (Persinger & Saroka, 2013).

A recent replication of our work (Tinoco, 2014) appears to resolve these issues. We look forward to further studies in the field.

Our analgesic effects from weak applied magnetic fields, beginning in 1994 (Fleming, et al., 1994, Martin, 2004, Gallic, 2007) were replicated by Thomas, Prato & Kavaliers in invertebrates (Thomas, 1997), rats (Shupak, 2004), and humans (Robertson, et al., 2010). A major review by an Italian research group (Seppia, et al., 2007) has demonstrated not only the effectiveness of these fields but their biochemical pathways. Similar research has been done by many others (Bao, 2006, Kortekaas, 2014,). Our work on analgesic effects continues up to the present (Murugan, 2014).

Our work on the geophysics of luminous displays (earth lights, ball lightning, etc) has been corroborated by several researchers. The same is true for our work in paranormal experiences and correlated geomagnetic field levels.

My original work (Persinger, 1969) concerning the effects of rotating magnetic fields on fetal development in rats was replicated by Ossenkopp (1972).

Our analysis of calcium aggregates in the brain from excessive seizure damage (Lafreniere et al, 1992) was replicated by Japanese researchers (Mori, 2000).

Our LORETA measures concerning mental time travel, that is measuring memories of experiences from the past and present and pre-experiences of the imagined future (Lavallee, et al., 2010) are consistent with what many others have measured, including Irish (2013).

It seems that one researcher didn’t replicate one of our results, and online commentators have taken this to mean that *none* of them have been replicated. This, in turn was distorted to imply that none of them *could* be. I have little doubt that this chain of rumors and distortions has its basis in the way some have been offended by my work on religion. Religious believers

don’t want to accept that the brain could be instrumental in religious belief, and “new atheists” are offended by the idea that religion and religious experiences reflect processes inherent to the human brain, and can thus be considered as intrinsic to our species.

Anyone who has taken the time to recreate the experimental or analytical conditions precisely have replicated and extended our results.

I hope this blog will clarify that much of our work has been replicated and that we look forward to persevering in our efforts.

Dr. Michael A. Persinger

REFERENCES

St-Pierre, L.S., and M. A. Persinger. “Experimental facilitation of the sensed presence is predicted by the specific patterns of the applied magnetic fields, not by suggestibility: re-analyses of 19 experiments.” *International Journal of Neuroscience* 116.19 (2006): 1079-1096.

Persinger, Michael A., and S. A. Koren. “A response to Granqvist et al. “Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak magnetic fields”.” *Neuroscience Letters* 380.3 (2005): 346-347.

Tinoca, Carlos A., and João PL Ortiz. “Magnetic Stimulation of the Temporal Cortex: A Partial “God Helmet” Replication Study.” *Journal of Consciousness Exploration & Research* 5.3 (2014).

Richards, Pauline M., Michael A. Persinger, and Stan A. Koren. “Modification of activation and evaluation properties of narratives by weak complex magnetic field patterns that simulate limbic burst firing.” *International journal of Neuroscience* 71.1-4 (1993): 71-85.

Granqvist, Pehr, et al. “Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak complex magnetic fields.” *Neuroscience Letters* 379.1 (2005): 1-6.

Kirschvink, Joseph L., et al. “Magnetite in human tissues: a mechanism for the biological effects of weak ELF magnetic fields.” *Bioelectromagnetics* 13.S1 (1992 A): 101-113.

Kirschivink, Joseph L., Kobayashi-Kisshvink, Atsuko & Woodford, Barbera J. “Magnetite biomineralization in the Human Brain”, *Proceedings of the National Academy of Science* 1992 (B), 89 7683-7687

Buckner CA, Buckner AL, Koren SA, Persinger MA, Lafrenie RM (2015) Inhibition of Cancer Cell Growth by Exposure to a Specific Time-Varying Electromagnetic Field Involves T-Type Calcium Channels. *PLoS ONE* 10(4): e0124136. doi:10.1371/journal.pone.0124136

M. **Persinger** and K. Saroka, “Minimum Attenuation of Physiologically-Patterned, 1μ Tesla Magnetic Fields through Simulated Skull and Cerebral Space,” *Journal of Electromagnetic Analysis and Applications*, Vol. 5 No. 4, 2013, pp. 151-156.

Fleming, Jennifer L., M. A. Persinger, and Stanley A. Koren. “Magnetic pulses elevate nociceptive thresholds: Comparisons with opiate receptor compounds in normal and seizure-induced brain-damaged rats.” *Electromagnetic Biology and Medicine* 13.1 (1994): 67-75.

Martin, L.J. , S.A. Koren, M.A. Persinger “Thermal analgesic effects from weak, complex magnetic fields and pharmacological interactions” *Pharmacology, Biochemistry and Behavior* 78 (2004) 217–227

Galic M.A. and Persinger M.A. “Lagged Association Between Geomagnetic Activity and Diminished Nocturnal Pain Thresholds in Mice” *Bioelectromagnetics* 28:577, 579 (2007)

Thomas, Alex W., et al. “Antinociceptive effects of a pulsed magnetic field in the land snail, Cepaea nemoralis.” *Neuroscience letters* 222.2 (1997): 107-110.

Robertson, John A., et al. “Evidence for a dose-dependent effect of pulsed magnetic fields on pain processing.” *Neuroscience letters*482.2 (2010): 160-162.

Del Seppia, Cristina, et al. “Pain perception and electromagnetic

fields.”*Neuroscience & Biobehavioral Reviews* 31.4 (2007): 619-642.

Bao, Xiuqi, et al. “A possible involvement of β - endorphin, substance P, and serotonin in rat analgesia induced by extremely low frequency magnetic field.” *Bioelectromagnetics* 27.6 (2006): 467-472.

Kortekaas, R., et al. “Weak field transcerebral pulsed electromagnetic fields in health care.” *Antennas and Propagation* (EuCAP), 2014 8th *European Conference on IEEE*, 2014.

Murugan, Nirosha J. , Lukasz M. Karbowski and Michael A. Persinger “Weak burst-firing magnetic fields that produce analgesia equivalent to morphine do not initiate activation of proliferation pathways in human breast cells in culture” *Integrative Cancer Science and Therapeutics*, 2014 Volume 1(3): 47-50

Persinger, Michael A. “Open-field behavior in rats exposed prenatally to a low intensity - low frequency, rotating magnetic field.” *Developmental psychobiology* 2.3 (1969): 168-171.

Ossenkopp, Klaus P. “Maturation and open-field behavior in rats exposed prenatally to an ELF low-intensity rotating magnetic field.” *Psychological Reports*, Vol 30(2), Apr 1972, 371-374.

Lafreniere, Ghislaine F., Oksana Peredery, and Michael A. Persinger. “Progressive accumulation of large aggregates of calcium-containing polysaccharides and basophilic debris within specific thalamic nuclei after lithium/pilocarpine-induced seizures.” *Brain research bulletin*28.5 (1992): 825-830.

Mori, Fumiaki, Kunikazu Tanji, and Koichi Wakabayashi. “Widespread calcium deposits, as detected using the alizarin red S technique, in the nervous system of rats treated with dimethyl mercury.” *Neuropathology* 20.3 (2000): 210-215.

Irish, Muireann, and Olivier Piguet. “The pivotal role of semantic memory in remembering the past and imagining the future.” *Frontiers in behavioral neuroscience* 7 (2013).

https://archive.is/lst5R

Blog Five

God Helmet Experiments use Blind Protocols and Placebo Controls – A blog by Dr. Michael A. Persinger

Our God Helmet experiments employ double-blind conditions and placebo protocols.

Our critics are mistaken when they claim we do not use proper controls. We are committed to the scientific method, especially in laboratory experiments, including subject blindness, experimenter blindness, control groups, and blindness by those who analyze our data.

Question: What are your standard double-blind and placebo controlled protocols?

Answer: Expectancy and confirmation bias are always important variables when human beings are measuring or being measured. Most of our major experiments over the last three decades with the *sensed presence* were double-blind. For a placebo, we use a "sham" or absent magnetic field, which we create by disconnecting the solenoids (magnetic coils) from the signal source. We also exploit all ways and means for ensuring that our subjects are not given any suggestions as to the purpose of the experiment.

Subject Expectations

The subjects volunteered for a relaxation study and were told (via a consent form) they might be exposed to a weak magnetic field. Four to six weeks prior to their participation, the subjects had completed intake questionnaires. Some critics have mistakenly said that our questionnaires (which asked about some spiritual and otherworldly experiences and beliefs) were administered immediately before the experimental sessions, and that this introduced inadvertent suggestions. In fact, our standard procedure is to separate the questionnaires from the sessions by an average of a month. They are eventually invited to participate in a "Relaxation Experiment", so they are unaware that the questionnaires given previously have any relation to the experiment. The subjects are kept in the experimentally blind condition. They are not influenced by expectations when coming into our lab. The lab itself looks like a busy workplace, and is not decorated with religious or spiritual images.

Blind Protocols

The experimenter, usually an undergraduate or graduate student, who runs the experiment, is not aware of the true hypothesis or mechanism.

One summary of our work with the *sensed presence* is our publication, "The sensed presence within experimental settings: implications for the male and female concept of self" The Journal of Psychology, 2003, 137, 5-16.

Here is a very brief summary of that experiment, with its 50 male and 50 female subjects.

In this study, we used a signal derived from burst-firing in the amygdala,

applying it over the temporal lobes via a set of four solenoids over each temporal lobe. We rotated the signal by turning them on and off in sequence. All of this was built into the hardware (The God Helmet) or coded into the software that drives it, written by Stanley Koren. We applied the signal for 10 minutes, gave it a 5 minute break, and applied it for another 10 minutes. This was done to avoid habituation. We observed double-blind conditions.

https://tinyurl.com/sensed-presence

"All participants were tested by experimenters who were not familiar with the purpose of the experiment."

"The participants were told that the experiment was concerned with relaxation."

Note that in some experiments, subjects were told that the experiment concerned memory. The relaxation and memory suggestions kept the subject in an experimentally blind condition.

The experimenter ran different patterns of magnetic fields created by Professor Stan Koren and me. Once the results were collected they were analyzed routinely by SPSS (statistical analysis) software.

Women reported more frequent experiences of a sensed presence than men did, and men were more likely than women to consider these experiences as "intrusions" from extrapersonal or ego-alien ("outside the self") sources. Both effects were predicted by one of our hypotheses (*vectoral hemisphericity*) and the known neurologically-based cognitive differences between right-handed men and right-handed women.

The point here is that we do in fact use double-blind conditions, and claims to the contrary are simply not true. Other examples, referenced here, include Richards (1992) Persinger (1994), Healey (1996), Persinger (1999), Persinger, (2002) Booth (2005), Tiller (2002), Corradini, (2014). I have emphasized this in my response to Pehr Granqvist, as follows:

> *"In all of our major studies, involving more than 400 subjects, during the last 20 years, the subjects were not aware of their experimental conditions and experimenters were not familiar with the hypotheses being tested or both were not aware of the*

experimental condition. Subjects had volunteered for "memory" or "relaxation" studies and were randomly or serially allocated to conditions. The "sensed presence" issue was never discussed. The person generating the hypothesis never had direct contact with the subjects." (Persinger, 2005)

Regrettably, online skeptics fail to include this critical reply to Dr. Granqvist.

Let me underscore that we have applied double-blind protocols in our "sensed presence" studies, (to make the differences in stimulation explicit) by quoting another of our papers:

"Under double-blind conditions, the subjects who were exposed to the burst-firing pattern presented over both hemispheres or the right hemisphere reported more sensed presences than those exposed to the sham-field [control] or to left hemispheric presentations. Subjects in the latter condition reported fewer sensed presences than the sham-field controls. (Booth, 2005 B)"

Here, stimulation of the right hemisphere is compared to both stimulation of the left, and to controls. This method allows greater certainty for our results.

Moreover, we often employ "blind" analysis of EEG and QEEG data, in which the person carrying out the analysis does not know what hypothesis the data is intended to study (Makarec, 1990).

In our rat studies, we also carry out blind analysis of rat brain sections, in which the investigator does not know which brain regions may have been affected by a procedure, or the magnitude of the differences predicted between the rat brains used in the study and those that weren't (Fournier, 2012). In rat studies investigating differences in rat behavior following stimulation with magnetic signals, the experimenter observing their behavior is kept blind to the experimental condition (Whissell, 2007, McKay, 2004, Bureau, 1994, Babik, 1992). Our examination of microscope slides from rat subjects and controls is also done under blind conditions (Cook, 1999). We have also carried out similar procedures with worm (planarium – *Dugesia sp.*) studies (Mulligan, 2012).

” …a total of 10 undergraduate students participated in measuring the worms’ activity; the students were unaware of the experimental conditions, that is, the study was completely “blind”.”

When we analyzed the congruence between intuitively-derived narratives (remote viewing), and the locales they viewed, we used groups of student “raters” who compare the two data sets, and rate the degree of congruence. All raters were “blind” in that they didn’t know anything about the circumstances under which the transcripts were created, or the overall purpose of the experiment (Hunter, 2010). We also employed the same technique to assess the accuracy of remote viewing by the artist Ingo Swann using graphic images he sketched during remote viewing sessions, augmented by our “Octopus” apparatus (Persinger, 2002b). In a related case history, we attempted to interpolate a specific image from a collection of art prints into the dreams of another. The “agent”, who repeatedly viewed a randomly-chosen (based on dice throws) art image, was the only one who knew which image was being used.

“The interviews were conducted double-blind; neither the percipient nor the experimenters knew the identity of the target or the pool of art prints from which the target had been randomly selected.”

The results demonstrated that greater accuracy was associated with lower geomagnetic activity.

Placebo Controlled, Double-Blind Studies.

Our placebo controls are created by using inert electromagnets (solenoids). These are not attached to the signal source. The experimental procedures are identical in all other respects. We also use our placebo fields in conjunction with double-blind conditions in our studies. Here are a few examples:

- Corradini’s (2014) study facilitating declarative memory
- Fournier’s (2012) experiment with prenatal rat hippocampus stimulation
- Mulligan’s (2012) study with *planaria*.
- Whissell’s (2007) experiment on the interactions of nitric oxide and seven hertz magnetic fields.

- Booth's (2005) *sensed presence* study.
-My own study on increased alpha activity from the left hemisphere with stimulation with our burst-firing pattern (Persinger, 1999).
- My study on enhanced hypnotic suggestibility (Persinger, 1996)
- A study that assessed the pleasantness of a long-term potentiation signal (Persinger, 1994).
- A study of coherent responses to Reiki between practitioners and clients (Ventura, 2014)
- An experiment with altered state experiences with circumcerebral magnetic stimulation (Collins, 2013)
- A study lowering depression and increasing alpha activity in the frontal lobe. (Corradini, 2013)

Sham (placebo) fields are also used in our studies with cell cultures (Murugan, 2014 A), water Ph (Murigan, 2014 B), Obesity in rats (St-Pierre, 2014), Suppression of Cancer cells, (Karbowski, 2012), energy storage in water (Gang, 2012), planeria studies (Gang, 2011) and scores of other studies that didn't use human subjects.

The issue of double-blind and placebo control in EEG studies is less important with our modern technology because of the availability of EEG normative ("averages") for different states, including placebo response states. Comparing the results of our EEG studies to standard normative EEG states allows us to make inferences that would have required baseline (control) readings just a few years ago (Congedo, 2010).

During the last 5 years, quantitative electroencephalographic measurements by computer and the algorithms to compute distributions of power within the volume of the brain for different frequency bands have become available. These have revealed that different patterns of fields, delivered to different sides of the brain, produce specific patterns regardless if the person *knows* if a field is presented or not (Saroka, 2013). Placebo effects produce very specific patterns that are not the same as those associated with either the field presentation or the field and the sensed presence effect.

In spite of claims to the contrary, we do use placebo controls and blind experimental conditions. Our emphasis has been on quantifiable data, replication, and blind conditions, wherever possible and appropriate. We

remain committed to the scientific method.

I hope this blog will clarify our use of blind conditions, and placebo controls in our laboratory.

Dr. Michael A. Persinger

REFERENCES

P.M**. Richards**, S.A. Koren, M.A. Persinger, Experimental stimulation by burst-firing weak magnetic fields over the right temporal lobe may facilitate apprehension in women, *Perceptual and Motor Skills* 75 (1992) 667–670.

Persinger MA, Richards PM, Koren SA. "Differential ratings of pleasantness following right and left hemispheric application of low energy magnetic fields that stimulate long-term potentiation." I*nternational Journal of Neuroscience*. 1994 Dec;79(3-4):191-7.

Healey F, Persinger MA, Koren SA. "Enhanced hypnotic suggestibility following application of burst-firing magnetic fields over the right temporoparietal lobes: a replication." *International Journal of Neuroscience*. 1996 Nov; 87(3-4):201-7.

Krippner, Stanley, and Persinger, Michael. "Evidence for enhanced congruence between dreams and distant target material during periods of decreased geomagnetic activity." *Journal of Scientific Exploration* 10.4 (1996): 487-493.

Persinger, M. A. "Increased emergence of alpha activity over the left but not the right temporal lobe within a dark acoustic chamber: differential response of the left but not the right hemisphere to transcerebral magnetic fields." *International Journal of Psychophysiology* 34.2 (1999): 163-169.

M.A. **Persinger**, F. Healey, Experimental facilitation of the sensed presence: possible intercalation between the hemispheres induced by complex magnetic fields, *Journal of Nervous and Mental Disorders*. 190 (2002) 533–541.

Booth, J. N., S. A. Koren, and M. A. Persinger. “Increased feelings of the sensed presence and increased geomagnetic activity at the time of the experience during exposures to transcerebral weak complex magnetic fields.” *International Journal of Neuroscience* 115.7 (2005 A): 1053-1079.

Tiller, S.G; Persinger, M.A., Geophysical variables and behavior: XCVII. Increased proportions of left-sided sense of presence induced experimentally by right hemispheric application of specific (frequency-modulated) complex magnetic fields, *Perceptual and Motor Skills*, 94 (2002) 26–28.

Persinger, Michael A., Letter to the Editor “A response to Granqvist et al. “Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak magnetic fields” *Neuroscience Letters* 380 (2005) 346–347

Makarec, Katherine,; Persinger, Michael A. “Electroencephalographic Validation of a Temporal Lobe Signs Inventory in a Normal Population”, *Journal of Research in Personality*, 24, 323-337 (1990)

Corradini, Paula L. Collins, Mark W. G. Persinger Dr. Michael A. “Facilitation of Declarative Memory and Congruent Brain States by Applications of Weak, Patterned Magnetic Fields: The Future of Memory Access?” *International Journal of Humanities and Social Science* Vol. 4, No. 13; November 2014, 30

Neil M. **Fournier**, Quoc Hao Mach, Paul D. Whissell, Michael A. Persinger “Neurodevelopmental anomalies of the hippocampus in rats exposed to weak intensity complex magnetic fields throughout gestation” International Journal of Developmental Neuroscience 30 (2012) 427–433

Whissell, P.D. , Persinger, M.A.; “Developmental effects of perinatal exposure to extremely weak 7 Hz magnetic fields and nitric oxide modulation in the Wistar albino rat ” International Journal of Developmental Neuroscience 25 (2007) 433–439

McKay, B. E., and M. A. Persinger. “Normal spatial and contextual learning for ketamine-treated rats in the pilocarpine epilepsy model.” *Pharmacology Biochemistry and Behavior* 78.1 (2004): 111-119.

Bureau, Y. R. J., O. Peredery, and M. A. Persinger. “Concordance of quantitative damage within the diencephalon and telencephalon following systemic pilocarpine (380 mg/kg) or lithium (3 mEq/kg)/pilocarpine (30 mg/kg) induced seizures.” *Brain Research*648.2 (1994): 265-269.

Missaghi, Babik, Pauline M. Richards, and Michael A. Persinger. “Severity of experimental allergic encephalomyelitis in rats depends upon the temporal contiguity between limbic seizures and inoculation.” *Pharmacology Biochemistry and Behavior* 43.4 (1992): 1081-1086.

Cook, Lisa L., and M. A. Persinger. “Infiltration of lymphocytes in the limbic brain following stimulation of subclinical cellular immunity and low dosages of lithium and a cholinergic agent.” *Toxicology letters*109.1 (1999): 77-85.

Mulligan, Bryce P., Noa Gang, Glenn H. Parker, Michael A. Persinger “Magnetic Field Intensity/Melatonin-Molarity Interactions: Experimental Support with Planarian (Dugesia sp.) Activity for a Resonance-Like Process” *Open Journal of Biophysics*, 2012, 2, 137-143

Hunter, M.D., Mulligan, B.P., Dotta, B. T., Saroka, K. S., Lavallee, C. F., Koren, S. A., & Persinger, M. A., “Cerebral Dynamics and Discrete Energy Changes in the Personal Physical Environment During Intuitive-Like States and Perceptions” *Journal of Consciousness Exploration & Research* December 2010, Vol. 1, Issue 9, pp. 1179-1197

Persinger MA, Roll WG, Tiller SG, Koren SA, Cook CM. “Remote viewing with the artist Ingo Swann: neuropsychological profile, electroencephalographic correlates, magnetic resonance imaging (MRI), and possible mechanisms.” *Perceptual and Motor Skills*. 2002(B) Jun;94(3 Pt 1):927-49.

Murugan, Nirosha J., Lukasz M. Karbowski, and Michael A. Persinger. “Weak burst-firing magnetic fields that produce analgesia equivalent to morphine do not initiate activation of proliferation pathways in human breast cells in culture.” (2014).

Murugan, N. J., L. M. Karbowski, and M. A. Persinger. “Serial pH Increments (~ 20 to 40 Milliseconds) in Water during Exposures to Weak,

Physiologically Patterned Magnetic Fields: Implications for Consciousness." *Water* 6 (2014): 45-60.

St-Pierre, Linda S., and Michael A. Persinger. "Progressive Obesity in Female Rats from Synergistic Interactions between Drugs and Whole Body Application of Weak, Physiologically Patterned Magnetic Fields." *Journal of Behavioral and Brain Science* 2014

Ventura, Anabela C., Kevin S. Saroka, and Michael A. Persinger. "Non-Locality changes in intercerebral theta band coherence between practitioners and subjects during distant Reiki procedures." *Journal of Nonlocality* 3.1 (2014).

Collins, Mark W. G. Persinger, Michael A. "Changing Velocity Circumcerebral Magnetic Fields Produce Altered State Experiences and Lowered Delta-Theta Power over the Temporal Lobes" Frontiers in Psychological and Behavioral Science Apr. 2013, Vol. 2 Iss. 2, PP. 26-29

Corradini, Paula L., and Michael A. Persinger. "Brief Cerebral Applications of Weak, Physiologically-patterned Magnetic Fields Decrease Psychometric Depression and Increase Frontal Beta Activity in Normal Subjects." *Journal of Neurology & Neurophysiology* (2013).

Karbowski, Lukasz M., et al. "Digitized quantitative electroencephalographic patterns applied as magnetic fields inhibit melanoma cell proliferation in culture." *Neuroscience letters* 523.2 (2012): 131-134.

Gang, N., L. S. St-Pierre, and M. A. Persinger. "Water dynamics following treatment by one hour 0.16 Tesla static magnetic fields depend on exposure volume." *Water* 3 (2012): 122-131.

Gang, Noa, and Michael A. Persinger. "Planarian activity differences when maintained in water pre-treated with magnetic fields: a nonlinear effect."*Electromagnetic biology and medicine* 30.4 (2011): 198-204.

Congedo, Marco, et al. "Group independent component analysis of resting state EEG in large normative samples." *International Journal of Psychophysiology*78.2 (2010): 89-99.

Saroka, Kevin & Persinger MA, "Potential production of Hughlings

Jackson's "parasitic consciousness" by physiologically patterned weak transcerebral magnetic fields: QEEG and source localization" Epilepsy and Behavior, 2013, 28, 395-407

Blog Six

The Tectonic Strain Theory and French's "Haunted Room" Experiment. My Tectonic Strain Theory is alive and well – a blog by Dr. Michael Persinger.

[Editor's note: This blog is only indirectly concerned with the God Helmet. It covers an erroneous attempt at using a schematic of one of our signals to try to apply it to a fake "haunted room". Despite claims to the contrary, there have been a number of replications, corroborations, and validations of my work with the Tectonic Strain Theory from several independent researchers.]

Misleading claims that my work with Tectonic Strain Theory (explaining most UFOs as coming from geomagnetic phenomena) has not been replicated are based on the mistaken belief that it's based on *experiments*. Instead, the theory is based on a series of statistical analyses (replication procedures are for experiments, not statistical arguments). To "replicate" a statistical study, one only has to obtain the data and perform the necessary calculations. In such a case, it would be more properly said to have been "corroborated" or "validated", than *replicated*. Critics, wanting to disparage my work in this

field, have pointed to a “Haunted Room” experiment, and incorrectly implied that it was a test of my work on the relationship between geomagnetic conditions and the propensity to report paranormal and other unusual experiences.

Question: Does Christopher French’s “haunted room study” have anything to do with your tectonic strain theory or the way you study the role of the earth’s magnetic field in paranormal experiences?

Answer: No. French’s experiment has little (if any) relationship to the tectonic strain theory, which explains the creation of luminosities (“lights in the sky”) before earthquakes. We have found that these correlate with UFO sightings, apparitions, and other phenomena. In brief, this theory tells us that electrical and magnetic fields produced by the bedrock while it’s being strained by geological pressure, (which is eventually discharged by an earthquake) create luminous displays, like earth lights, ball lightning, and sometimes dramatic lights in the sky. We also find that these fields can create unstable conditions in the brain, especially the deep portions of the temporal lobes. This instability can lead to hallucinatory experiences, which lead people to interpret them in terms of their cultural and learning history as well as their private beliefs, so they are interpreted and then seen as spirits, the Virgin Mary, angels, alien spacecraft or ghosts. This idea has recently been independently proposed by another researcher, who hypothesizes that “ball lightning” may induce hallucinations (Witze, 2010). My first publication in the field (1976) used the same concept to explain UFO reports.

A PHOTO OF "BALL LIGHTNING"
Picture by Joe Thomissen
GNU license from Wiki Commons

French's experiment consisted of trying to construct a "haunted room" by building a room and filling it with magnetic signals and infrasound. The experiment did not succeed. French is a well-known skeptic, but not experienced in the proper use of the "complex magnetic" neural stimulation we use in our lab. We have been able to perform several experiments successfully, inducing paranormal experiences, and apparitions, using this technology, applied using the God Helmet.

French's experiment used a wave pattern that could not have created the conditions for synthetic paranormal experiences because he was not able to generate the appropriate point durations we use in our lab. The point durations (how long each bit of the signal lasts) are so important that altering them makes them ineffective. I e-mailed him and offered to share the equipment but he declined, and instead chose to develop his own apparatus, including a procedure in which "The … burst pattern was generated by constructing a table of values from (a) graph of the waveform used and then converting these numeric values…" (French, et al., 2008)

The graph French refers to here is a graph of point (X axis) and Field strength (Y axis). However, the graph doesn't display the *durations* of the

points on the X axis. We have kept that specific parameter flexible in order to allow experimentation with different point (or *pixel*) durations. Incorrect point durations will yield ineffective signals. Our many experiments with varying point durations have shown us that precision in this regard is critical. A metaphor may help. It's as though we hear the phrase "clean the turpentine brushes" as "queen of serpentine buses". The majority of the phonemes may be correct, but the information content will be absent, and the words won't get an appropriate response.

My colleague Todd Murphy, who has developed multiple systems that effectively deliver our (complex magnetic) signals, points out in a brief web entry that Christopher French used the "Goldwave" audio editor to render his signals. Professor Murphy used this same method early in 1999 for the first draft of his signals, which did not work. His signals became effective only after he introduced his proprietary methods for developing the signals the following year. We validated their effectiveness in one paper) (Tsang, 2004). The techniques used to render effective audio equivalents to our (God Helmet) signals were not applied in French's Study. Prof. Murphy informs me that his signals were drafted eighteen times overall.

French (at al.) edited his signal "into a 16-bit wav file using Goldwave (software) at a sample rate of 1000 Hz for playback via the computer's soundcard." It may be relevant that Murphy's signals do not use this sampling rate.

Subjects in our experiments are informed that they're participating in a "relaxation experiment". French's subjects were "… informed in advance that they might experience unusual sensations whilst in the chamber …" The difference in "priming" may have predisposed his subjects towards apprehensiveness, facilitating arousal (anxious feelings), which we've found reduces effect sizes.

It may also be relevant that the background sound levels in the French study were significantly above the values we require to obtain the sensed presence. That's why we employ the acoustically silent chamber. When we first started the research 30 years ago, we employed New Age Music while the fields were presented and found the sensed presence was actually reduced. That's why music was removed from the protocol. In addition,

because the temporal lobes respond to the applied fields (as our neuroimaging profiles indicate) and sound from any source is also represented within the temporal lobes, any sounds can interfere with the effect. A significant portion of temporal lobe's default mode activity is dedicated to monitoring ambient sound. Employing a truly silent environment recruits this activity into the neural responses to the signals.

Perhaps the most important difference between our procedures and those employed by French (at al.) is that they used a room to apply the signals, while we utilize a helmet, designed for the human head. Our equipment allows us to apply our signals to either the left or right temporal lobes or both. Our "sensed presence" protocol involves stimulation of one hemisphere (the right) with one signal (derived from a "chirp" sequence) followed by another signal over both hemispheres. This optimal design for eliciting the sensed presence has been published in the literature (Persinger, 2001).

Utilizing an entire room to apply the signals means that 1) brain regions outside the temporal lobes aren't excluded from the stimulation, and 2) it becomes impossible to target only one of the temporal lobes, as we commonly do in our work. In fact, we have applied our signals in the context of a whole room, and found that whole-body exposures have minimal effects, if any, even when the signals are produced correctly. We did not publish the study, due to its trivial character, and the non-trivial efforts required by scientific journals for publications.

There are a few online sources that mistakenly claim that our work in this area has not been replicated. This is not the case.

Several kinds of research combine to support our geophysical research in this area. The US Geological Survey has reported earth lights in conjunction with earthquakes. Here is one example:

> "During and immediately after the main shock, 'earthquake lights' of white to bluish flashes or glows lasting several seconds were reported by a number of observers. Earthquake lights are associated with major earthquakes and have been observed in Japan and California. The lights are believed to be results of earthquake-induced distortions of the atmosphere."

Several researchers have confirmed our ideas about “earthlights”, and the idea has, in fact, become commonly-accepted (as for example in Smithsonian Magazine, Stromberg, 2014), though there continues to be debate on the subject. A direct replication of some of my research appears in a study by Thériault (2014) titled “Prevalence of Earthquake Lights Associated with Rift Environments” in *Seismological Research Letters.* NASA now recognizes earthquake lights as *precursors for earthquakes* (Bluck, 2001).

> “When the rocks in the Earth’s crust crackle and buckle under the onslaught of tectonic forces, the charges that are dormant in them are set free. They give rise to a dazzling array of phenomena, long known to mankind and even part of folklore in earthquake-prone regions around the globe,” said Freund. “These phenomena range from anomalous electric and magnetic signals, to ‘earthquake lights’ that illuminate the mountain tops and strange animal behavior as well as ionospheric effects that impact how radio waves travel over long distances.”

Japanese researchers (Takaki, 1998) have also observed “Change in seismic stress releases piezo-compensating, bound charges due to changes in the piezoelectric polarization of quartz grains in granitic rocks, which produces an intense electric field at the fault zone. The excited or ionized molecules by free electrons accelerated under the electric field produce luminous phenomena in the atmosphere” The also proposed “A model of dark discharge in the atmosphere before a large earthquake was proposed to elucidate the mechanism of generation of earthquake lightning and related electroatmospheric phenomena. Change in seismic stress releases piezo-compensating, bound charges due to changes in the piezoelectric polarization of quartz grains in granitic rocks, which produces an intense electric field at the fault zone.

Researchers at Rutgers University have carried out experiments that support the concept of earthquake lights by emulating earthquake conditions in the lab (Shinbrot, 2012). These are reported as often being mistaken for UFOs, as in my tectonic strain theory of unusual events.

John Derr, a pioneer in this field of study, was one of the first to propose

that geophysical strain could explain earthlights, and other luminous phenomena (Derr, 1986).

Paul Deveraux has published several books of his independent investigations showing the association of these earth lights with paranormal phenomena, which constitutes a replication and confirmation of my work in this area.

To summarize, Christopher French's "haunted room" experiment was not a test of the tectonic strain theory in any way. This theory has been independently validated, both in its geophysical hypothesis (that geological strain prior to earthquakes produces earth lights) and its power to explain paranormal (apparitions and UFOs) phenomena.

The theory met with criticism from one researcher, soon after it was published, and I published a reply (Persinger, 1985).

I hope this blog will help to clarify my Tectonic Strain Theory, and to underscore that I am far from alone in these concepts.

Dr. Michael A. Persinger

References

French CC, et al., The "Haunt" project: An attempt to build a "haunted" room by manipulating complex electromagnetic fields and infrasound, *Cortex* (2008), j.cortex.2007.10.011.

Persinger, M. A., Transient geophysical bases for ostensible UFO-related phenomena and associated verbal behavior? *Perceptual and Motor Skills*, 1976, 43, 215-221.

Witze, Alexandra. "'Ball lightning'may be hallucinatory." *Science News*(2010): 12-12.

Robert Thériault, France St-Laurent, Friedemann T. Freund and John S. Derr "Prevalence of Earthquake Lights Associated with Rift Environments" Seismological Research Letters, 2014 V. 85, No. 1 Pg. 159-178

Tsang EW, Koren SA, Persinger MA. "Electrophysiological and

quantitative electroencephalographic measurements after treatment by transcerebral magnetic fields generated by compact disc through a computer sound card: the Shakti treatment." *International Journal of Neuroscience*. 2004 Aug;114 (8):1013-24.

Murphy, Todd "Christopher French's "Haunted Room" Experiment: A brief commentary." Online posting, 2014 http://www.god-helmet.com/wp/french_haunted_room.htm

Persinger Michael A, "The Neuropsychiatry of Paranormal Experiences" Journal of Neuropsychiatry and Clinical Neurosciences13:4, Fall 2001

Bluck , John NASA press release,

Shunji Takaki, Motoji Ikeya "A Dark Discharge Model of Earthquake Lightning" *Japanese Journal of Applied Physics* 09/1998; 37(9A):5016-5020.

Troy Shinbrot, Nam H. Kim, and N. Nirmal Thyagu "Electrostatic precursors to granular slip events" *Proceedings of the National Academy of Sciences*, 2012 vol. 109 no. 27 10806–10810

Stromberg, Joseph "Why Do Lights Sometimes Appear in the Sky During An Earthquake?" smithsonian.com, January 2, 2014 https://www.smithsonianmag.com/science-nature/why-do-lights-sometimes-appear-in-the-sky-during-an-earthquake-180948077/

P. **Devereux**, "Earthquake Lights Revelation," Blandford, London, 1989.

Derr, John S. "Rock mechanics: Luminous phenomena and their relationship to rock fracture" ***Nature*** 321, 470 – 471 (29 May 1986)

Corroborating studies:

Lipnicki DM. "An association between geomagnetic activity and dream bizarreness." *Medical Hypotheses*. 2009 Jul;73(1):115-7.

Conesa J. "Isolated sleep paralysis, vivid dreams and geomagnetic influences: II. Perceptual and Motor Skills. 1997 Oct;85(2):579-84.

Rapoport SI, Boldypakova TD, Malinovskaia NK, Oraevski? VN,

Meshcheriakova SA, Breus TK, Sosnovski? AM. “Magnetic storms as a stress factor.” *Biofizika* [Biophysics]. 1998 Jul-Aug;43(4):632-9.

Dimitrova S, Stoilova I, Cholakov I. “Influence of local geomagnetic storms on arterial blood pressure.” *Bioelectromagnetics*. 2004 Sep;25(6):408-14.

Haraldsson, Erlendur; Gissurarson, Loftur R. “Does geomagnetic activity effect extrasensory perception? Personality and individual differences, 1987, v8 (n5):745-747

Berk M, Dodd S, Henry M. “Do ambient electromagnetic fields affect behaviour? A demonstration of the relationship between geomagnetic storm activity and suicide” *Bioelectromagnetics*. 2005 Nov 22;27(2):151-155

Raps A, Stoupel E, Shimshoni M. “Geophysical variables and behavior: LXIX. Solar activity and admission of psychiatric patients. *Perceptual and Motor Skills*. 1992 Apr;74(2):449-50.

Persinger, M.A., 1985. Geophysical variables and behavior: XXVI. A response to Rutkowski's critique of the tectonic strain hypothesis for UFO phenomena. *Perceptual and motor skills*, *60*(2), pp.575-582.

An Incomplete Bibliography of my papers on geomagnetic effects:

Persinger, Michael A. “Geophysical variables and behavior: XXX. Intense paranormal experiences during days of quiet, global geomagnetic activity” *Perceptual and Motor Skills* 1985 Aug v61 (n1): 320-322

Arango, Manuel A.; Persinger, Michael A. “Geophysical Variables and Human Behavior: LII Decreased Geomagnetic Activity and spontaneous Telepathic Experiences from the Sedgwick collection. *Perceptual and Motor Skills*, 1988 Dec v67 (n3):907-909

Persinger, Michael ; Krippner, Stanley. “Dream ESP and Geomagnetic Activity” *Journal of the American Society for Psychical Research*, 1989 Apr v83 (n2):101-116.

Makarec, K.; Persinger, Michael A. Geophysical variables and behavior

XLIII “Negative correlation between Geophysical Variables between accuracy of card-guessing and geomagnetic activity: A Case Study” *Perceptual and Motor Skills*, 1987 Aug, v65 (n1) 105-106

Gearhart, Livingston; Persinger, M.A. Geophysical variables and behavior XXXIII. Onsets of historical and contemporary poltergeist episodes occurred with sudden increases in geomagnetic activity. *Perceptual and Motor Skills*, 1986 Apr v62 (n2) 463-466

Persinger MA. “Out-of-body-like experiences are more probable in people with elevated complex partial epileptic-like signs during periods of enhanced geomagnetic activity: a nonlinear effect.” *Perceptual and Motor Skills.* 1995 Apr; v80 (2):563-9.

Schaut, George B., Persinger, Michael A. “Subjective telepathic experiences, geomagnetic activity, and the elf hypothesis: I Data Analysis” *PSI Research*, 1958 Mar, v4 (n1):4-20

Berger R.E.; Persinger, M.A. “Geophysical variables and behavior: LXVII. Quieter annual geomagnetic Activity and effect Size for Experiemntal psi (ESP) studies over six decades”. *Perceptual and Motor Skills*, 1991 Dec, v73 (n3, Pt2 Spec issue):1219-1223

Persinger, Michael A.; Nolan, Michael “Geophysical variables and behavior XX. “Weekly numbers of mining accidents and the weather matrix: The importance of geomagnetic variation and barometric pressure. *Perceptual and Motor Skills*, 1984 Dec, v59 (n3):719-722

Lewicki, Dougals R.; Schaut, George H; Persinger, Michael A. “Geophysical variables and behavior XLIV. Days of subjective precognitive experiences and the days before the actual events display correlated geomagnetic activity” *Perceptual and Motor Skills*, 1987, aug, v65 (n1):173-174

Persinger, Michael A. “Geophysical variables and behavior: L Indications of a tectonic strain factor in the Rutlidge (UFO) observations during 1973 in southwest Missouri” *Perceptual and Motor Skills*, 1988 Oct, v67 (n2): 571-575

Persinger, M.A.; Derr, J.S. “Geophysical variables and behavior: XXII. Relations between UFO reports within the Uinta Basin and local seismicity” *Perceptual and Motor Skills* 1985, Feb; 60 (1) :143-152

Persinger, M.A.; Derr, J.S. “Geophysical variables and behavior: XXXII. Evaluations of UFO reports in an area of infrequent seismicity: The Carmen, Manitoba episode.” *Perceptual and Motor Skills*, 1985 Dec, v61 (n3, Pt1): 807-813

Derr, J.S.; Persinger, M.A. “Geophysical variables and behavior: LXXVI. Seasonal hydrological load and regional luminous phenomena (UFO reports) within river systems, the Mississippi Valley test” *Perceptual and Motor Skills*, 1993 Dec, v77 (n3, Pt62), 1163-1170

Matteson, Dan; Persinger, M.A. “Geophysical variables and behavior: XXXV. Positive correlations between numbers of UFO reports and earthquake activity in Sweden.” *Perceptual and Motor Skills*, 1986 Oct, v63 (n2, Pt2) 921-922

Persinger, M.A.; Derr, J.S. “Geophysical variables and behavior: LXII. Temporal coupling of UFO reports and seismic energy release within the Rio Grande rift system: discriminative validity of the tectonic strain theory.” *Perceptual and Motor Skills*, 1990 Oct, v71 (n2): 567-57

Persinger, M.A.; Derr, J.S. “Geophysical variables and behavior: XIX Strong temporal relationships between inclusive seismic measures and UFO reports within Washington state. *Perceptual and Motor Skills*, 1984, 59, 551-566

John S. Derr & Michal A. Persinger ‘Geophysical Variables and Behavior: LIV. Zeitoun (Egypt) Apparations of the Virgin Mary as Tectonic Strain-induced Luminosities. *Perceptual and Motor Skills*1989, 68, 123-128

Blog Seven

Richard Dawkins in the experimental chamber.

Richard Dawkins – Alcohol and the God Helmet don’t mix. Dawkins had been drinking before his God Helmet Session, and that can interfere with its effects – a Blog by Dr. Michael Persinger.

Question: Richard Dawkins is seen drinking wine or wine mixed with soda water (a “Wine Cooler”) before his session with the God Helmet in the BBC video showing his visit to your lab. *Had* he been drinking before the session? Will alcohol interfere with the God Helmet effects?
(Image provided by Dr. M.A. Persinger)

Answer: Yes, he had been drinking. The scent was easily noticed. In addition, he was obliged to sit in hot lights within the chamber for almost an hour as the BBC director managed several television studio details before the experiment began. This forced us to deviate from our typical protocol where the person walks into the dimly lit chamber and we begin the experiment within a few minutes. We have found that intoxication, particularly alcohol, interferes with the experimental induction of the sensed presence. That is why we always employed an EEG monitoring at the time of the exposure. If the brain state is not optimal, not unlike the calm or relaxation that facilitates meditation or prayer, the fields don’t optimally interact.

In addition, Dawkins had a low score for temporal lobe sensitivity, as mentioned on several web pages. Ordinarily, there are ways we can compensate, but these conditions made it difficult. Getting a subject to relax can take time before the session begins, and on that occasion, we were already pressed for time. Interested readers can see "The neurotourist: Postcards from the Edge of Brain Science", where author Lone Frank, who visited our lab, tells how her EEG showed she wasn't in the right frame of mind, and we waited until our EEG showed she was ready. BBC procedures and Dawkins' perfectly reasonable impatience made this impossible. I have not mentioned these aspects of Dawkins experience in our lab as a courtesy to those involved, but the large and growing number of web pages discussing this case has made it clear that withholding these details now serves to distort the truth.

Two other prominent skeptics, Dr. Susan Blackmore and Michael Shermer, had phenomena-rich God Helmet sessions in our lab. Michael Shermer (editor of *Skeptic* Magazine) said that he had "…not only a sensed

presence experience but an out-of-body experience as well", Dr Susan Blackmore said: "When I went to Persinger's lab and underwent his procedures I had the most extraordinary experiences I've ever had," she says. "I'll be surprised if it turns out to be a placebo effect." These are relevant in view of the mistaken online claim that the God Helmet doesn't work on skeptics.

Nevertheless, in spite of these limitations, Richard Dawkins did have some effects, but they were somatic, and not cognitive or affective, as we usually see. He reported a mild dizziness and twitching in his legs and a "twitchy" feeling in his breathing.

I hope that this brief blog will lend clarity to this well-known case history.

Dr. Michael A. Persinger

Blog Eight

My Theories are not Based on Religiousness in Epileptics.

(A Blog by Dr. M.A. Persinger)

Question: Are "microseizures" (a concept you have used to help explain religious experiences) actually epileptic events?

Answer: No, although they do have some things in common with Temporal Lobe epileptic events (seizures) because they originate from the same source; i.e., moments of instability in the temporal lobes, most particularly in it's deeper (limbic) regions. Most phenomena that share a common cause are distributed along a continuum (or spectrum) of intensity with degrees of "how much" (or how *strong*). For example, a few times during their lives, for brief periods, most people display the symptoms that define depression, thought disorders (such as schizophrenia) and personality disorders. However, it is only when the symptoms *dominate* the person's behaviors more or less continuously, that the condition is considered abnormal. To use a metaphor, ordinary religious experiences rely on brief "unsettled" conditions in the temporal lobes, but not full temporal lobe epileptic seizures.

"Microseizures" is a term I borrowed from Goldensohn (1975, 1983) who described the epileptic activity from the small columns within the brain's surface layer (The cortex) induced by surgical electrodes. He used the word to indicate subclinical electrical patterns that shared some features with (but were not the same as) epileptic events. A more recent publication (Stead, et al., 2010) describes Goldensohn's findings as follows:

> *"They demonstrated focal evolving microepileptiform discharges after penicillin injection on single electrodes in an array of electrodes spaced 2 mm apart with no reflection of the discharges on adjacent electrodes."* (Stead, 2010)

In other words, electrical discharges creating EEG (electroencephalographic) patterns similar to epileptic activity can appear from the brain. These do not spread to other areas the way true epileptic seizures do. Note that in the above quotation, such activity was read from one sensor, but the other, only two millimeters away, did not detect it. This has

been the primary exemplar of microseizures in my work. To clarify further, microseizures are non-epileptic events that mimic seizural activity, taking place in exceedingly small ("pinpoint") volumes of brain space.

My theory of the continuum (or *spectrum*) of temporal lobe sensitivity (*lability*) (offered as an explanation for the wide differences between religious and non-religious personality types and the propensity to report religious experiences) is not based on the rich literature demonstrating links between religiosity and temporal lobe epileptics (and, more broadly, temporal lobe foci). This link has been repeatedly observed and is still observed in some populations. Instead, my theory is based on laboratory measurements of normal, non-epileptic people. I think it's important to emphasize that the research began and continues to be focused on creativity and the factors that allow human beings to adapt to complex and ever changing environments and circumstances. Sensitivity, but without actual epilepsy, at the upper end of the continuum of temporal lobe lability is associated with remarkable creativity.

Many epileptics have had religious experiences, but only a very small minority of people who report such experiences are epileptics. Moreover, only a very small percent of all epileptics report such experiences. We can easily understand how the relative importance of religion in human cultures has given them a disproportionate prominence in the literature surrounding the study of the neurological aspects of religion and spirituality, i.e., the field of neurotheology.

The sensed presence is a primary feature of above-average temporal lobe sensitivity. It has been given different labels that range from the Muses of the Ancient Greeks to the "spirit guides" of contemporary New Age religion and philosophy. My working explanation is that the sensed presence is the left hemispheric awareness of the right hemispheric equivalent of the sense of self. We have demonstrated the direction effect across the two hemispheres and lobes by neuroimaging.

Goldensohn ES. Initiation and propagation of epileptogenic foci. In: JK Penry and DD Daly, editors. *Advances in neurology*. New York: Raven Press; 1975.

Matt **Stead** (et al.) "Microseizures and the spatiotemporal scales of

human partial epilepsy” *Brain*. 2010 Sep; 133(9): 2789–2797.

Goldensohn ES., “Symptomatology of nonconvulsive seizures: ictal and postictal.” *Epilepsia*. 1983;24 Suppl 1:S5-21.

Blog Nine

Is religiosity an epileptic phenomenon?

Religious belief is not an epileptic phenomenon – (A Blog by Dr. M.A. Persinger)

Answer: The answer to the question, as stated, is “no”. The microscopic connections between brain cells which are associated with certain personalities are altered by conditions within the temporal lobes that encourage frequent and very specific types of electrical patterns. Only very extreme brief electrical activity that involves large volumes of the brain defines epilepsy.

It’s important to differentiate three components: religious experiences, religious beliefs and religiosity (the propensity for interpreting events in terms of religious beliefs, as well as participating in religious rituals, showing reverence for religious symbols, etc.). A religious *experience* will include perceptions that involve multiple areas but particularly the temporal lobes because they contain the amygdala, which is involved with meaning and affect and the hippocampus, which is involved with memory and inner imaging. However, like any other experiences, religious or spiritual events are turned into verbal descriptions when we remember them. This involves or “recruits” the frontal portions of the brain.

Even when it’s subtle, the way a person labels the “cause” of a mystic experience, or what they attribute it to, is supplied by the person’s culture and learning history and this can have a significant effect on how they remember the experience, hours to days later. To offer a mundane example, people often hear words that upset them (for example, during arguments). After the event has passed, they are very likely to speak of it referring to the words that affected them, and not a description of the discomfort they created. The explanation supplants memories of the actual event. This also happens with religious experiences. The phenomena are recalled as instances and verifications of the themes in their religious beliefs.

The images associated with the words that we use to label a religious experience, without actively doing anything, strongly affect what we later remember as true. A religious belief, like all beliefs, is a cognitive strategy.

Religious beliefs attempt to anticipate both events in the world, and our life experiences (including religious experiences) and organize their meaning. Religious belief is different from a religious experience. A delusion differs from a belief to the extent that it affects the person's explanations and perceptions of his or her own private world. Religiosity is the degree to which the experience infuses what the person perceives, thinks, and believes about the world and explains the cosmos. Delusions have implications about the person who has them, while religiosity includes beliefs about the entire universe, including its origins and eventual end. Given that science also offers a cognitive strategy for anticipating events and interpreting their significance, maintaining a religious ideational framework ("belief system") and its accompanying paradigms *cannot* be regarded as an epileptic phenomenon.

ABOUT THE AUTHOR / EDITOR

Todd Murphy became a member of Laurentian University Behavioral Neurosciences group (The God Helmet's Laboratory) in 1998, after an extended mentorship under Dr. Michael A. Persinger. Prof. Murphy

developed PC versions of Dr. Persinger's neural stimulation technologies. Persinger & Murphy also co-published several scientific journal articles. Todd Murphy has also written two books on the neuroscience of spirituality and has a nine hour video lecture series on YouTube. Persinger's (2015) letter of credentials, testifying to Murphy's expertise with the God Helmet, is on the final page of this book.

Also By Todd Murphy:

Sacred Pathways: The Brain's Role in Religious and Mystic Experiences. Forewords by Dr. Michael A. Persinger and His Holiness, The Dalai Lama.
https://tinyurl.com/murphy-sacred-pathways

Déjà vu & Other Spiritual Gifts: Enrich Your Spiritual Life with Easy Exercises from Brain Science.
https://tinyurl.com/murphy-deja-vu

3 June 2015

To Whom It May Concern,

There have been occasional questions concerning the origin and similarities of the "God Helmet" technology and applications created by Stanley Koren and myself and those developed by Todd Murphy. This letter is to clarify any ambiguity. Todd Murphy's Shiva Neural Stimulation System's God Helmet is a faithful reproduction of our laboratory apparatuses. In addition his Basic Shiva System is a faithful reproduction of our circumcerebral "Octopus". The Shakti System is a viable alternative that accurately renders our signals and performs the stimulation.

We employ our DAC-based God Helmet, the SAM 360 modification and the Octopus in the laboratory to produce predictable alterations in cerebral activity and behaviour that include altered (mystical) states, enhanced creativity, and reduction of dysphoria. The latter has been employed for human subjects and in animal experiments to pursue the physiological mechanisms. Professor Murphy's equipment has also been employed to elicit these effects.

I heartily endorse Todd Murphy's Shiva Neural Simulation System's God Helmet and Basic Shiva System. They are the only magnetic stimulation systems originating from our equipment, concepts, and theories. We have demonstrated the equivalence between Todd Murphy's and our equipment by informal and formal experiments some of which are published in the scientific literature. The inventor of these systems, Todd Murphy, was a Member of the Laurentian University Neuroscience Research Group while he was creating and developing these devices and he continues to be a Senior Member of the Group.

Thank you,

Michael A. Persinger, Ph.D.
Full Professor
Behavioural Neuroscience, Biomolecular Sciences and Human Studies Programs
Departments of Psychology and Biology

Chemin du lac Ramsey Lake Road, Sudbury, ON Canada P3E 2C6 www.laurentian.ca www.laurentienne.ca

[1] Including Michael Shermer and Susan Blackmore.

[2] This signal is derived from the amygdala, a very emotional structure, and is the foundation for emotions from fear to bliss. It's also very *social*, helping us recognize what others are feeling, and what their words and action mean for us.